BLM LIBRARY
88047894

South Fork Eel River Watershed Analysis

Version 1.0
December 1996

Bureau of Land Management Arcata Resource Area
Six Rivers National Forest
U.S. Fish and Wildlife Service Coastal California Fish and Wildlife Office

BLM LIBRARY
RS 150A BLDG. 50
DENVER FEDERAL CENTER
P.O. BOX 25047
DENVER, CO 80225

The United States Department of Agriculture (USDA) Forest Service and the United States Department of Interior (USDI) Bureau of Land Management are diverse organizations committed to equal opportunity in employment and program delivery. USDA and USDI prohibit discrimination on the basis of race, color, national origin, sex, religion, disability, political affiliation and familial status. Persons believing they have been discriminated against should contact the department Secretary, U. S., Department of Agriculture or Department of the Interior, Washington, D.C. 20250 or call 202/720-7327.

BLM/CA/PT-97/006+7210

Printed on recycled paper

+D880479844

GB
772
.C2
S68
1996

Prepared By:

David Fuller, Fisheries Biologist, BLM Arcata Resource Area (lead)
Hank Harrison, Forester, BLM Arcata Resource Area
Kathy Heffner-McClellan, Social Scientist, Six Rivers National Forest
Tom Keter, Anthropologist, Six Rivers National Forest
Lisa Hoover, Botanist, Six Rivers National Forest
Jeff Mattison, Wildlife Biologist, Six Rivers National Forest
Liz McGee, Ecologist, Six Rivers National Forest
Lisa Mizuno, Fisheries Biologist, Six Rivers National Forest
Paul Roush, Wildlife Biologist, BLM Norhern California Resource Areas
Lucy Salazar, Fire Specialist, Six Rivers National Forest
Mark Smith, Geologist, Six Rivers National Forest
Joanne Spitler, Wildlife Biologist, US Fish and Wildlife Service
Jan Werren, GIS Specialist, Six Rivers National Forest
Ken Wright, Planning Analyst, Six Rivers National Forest

Contributors/Technical Support

Elaine Adams, Wildlife Biologist, US Fish and Wildlife Service
Marcia Andre, District Ranger, Six Rivers National Forest
Jennifer Anthony-Wheeler, Botanist, BLM Arcata Resource Area
Dan Averill, Natural Resource Manager, BLM Arcata Resource Area
Bruce Cann, Outdoor Recreation Planner, BLM Arcata Resource Area
Julie Goodwin, Archeologist, BLM Arcata Resource Area
Greg Goldsmith, Fisheries Biologist, US Fish and Wildlife Service
Bret Harvey, Aquatic Ecologist, US Forest Service Pacific Southwest Research Station
Steve Hawks, Wildlife Biologist, BLM Arcata Resource Area
Tom Jimerson, Forest Ecologist, Six Rivers National Forest
Sam Morrison, Geologist, US Forest Service Pacific Southwest Research Station
Cynthia Nelson, Editor, Independent Contractor
John Price, GIS Specialist, BLM Arcata Resource Area
Lance Reiland, Engineer, Six Rivers National Forest
Lynda Roush, Area Manager, BLM Arcata Resource Area

BLM LIBRARY
RS 150A BLDG. 50
DENVER FEDERAL CENTER
P.O. BOX 25047
DENVER, CO 80225

List of figures (page number)

Figure 1. Location of South Fork Eel Watershed within Eel Basin, northwestern California. (3)

Figure 2. Public and private ownership of lands within the South Fork Eel Watershed. (4)

Figure 3. Nesting and roosting habitat currently available for Northern Spotted Owl in the South Fork Eel Watershed, as modeled from TTF data. (38)

Figure 4. Nesting, roosting and foraging habitat currently available for Northern Spotted Owl in the South Fork Eel Watershed, as modeled from TTF data. (39)

Figure 5. Dispersal habitat currently available for Northern Spotted Owl in the the South Fork Eel Watershed, as modeled from TTF data. (42)

Figure 6. Late-Successional Reserves and critical habitat for Northern Spotted Owl and Marbled Murrelet within the South Fork Eel Watershed. (45)

Figure 7. Marbeled Murrelet zones within the Eel River Basin. (46)

List of tables

Table 1. The distribution of Wildlife Habitat Relationship (WHR) vegetation types in the South Fork Eel River watershed. (7)

Table 2. The distribution of size classes in the South Fork Eel River watershed. (8)

Table 3. Threatened, endangered, proposed and special status species in the Eel River Basin. (34--35)

Table 4. The Northwest Forest Plan land allocations and vegetation series of northern spotted owl nesting/roosting habitat on BLM land in the South Fork Eel River watershed. (37)

Table 5. Late-Successional Reserves and northern spotted owl critical habitat in the South Fork Eel River watershed. (40)

Table 6. South Fork Eel River northern spotted owl pairs and territorial singles. (41)

Table 7. Preliminary analysis using TTF Data of the number of acres of northern spotted owl suitable habitat within a 1.3-mile radius circle of selected activity centers in the South Fork Eel River watershed. (43)

Table 8. The risk values and ratings indicating trends in measured in risk annually and for the period of 1981-93. (61)

Table of Contents

Preface

CHAPTER 1 1
Watershed Characterization 1
Land Status 1
Geology 1
Geomorphology 5
Hydrology 5
Soils 6
Fisheries 6
Vegetation 6
Fire and Floods 8
Wildlife 8
Social 9

CHAPTER 2 11
Issues and Key Questions 11
Background 11
Issue 1: Water quality related to human uses and needs 11
Issue 2: Anadromous fish 11
Issue 3: TES species recovery 12
Issue 4: Access 13

CHAPTER 3 15
Reference Conditions, Current Conditions; Synthesis and Interpretation 15
ISSUE 1 15
Water Quality Related to Human Uses and Needs 15
Reference conditions 15
A. Prehistory 15
B. Historic uses 16
Current conditions 17
A. Summary of interview data and description of social groups 17
B. Major human uses 18
Synthesis and interpretation 21
ISSUE 2 25
Anadromous Fish 25
Reference conditions 25
Geology and watershed 25
Fisheries 26
Current conditions 26
Geology and watershed 26
Fisheries 27
Synthesis and interpretation 28

ISSUE 3 32
Threatened, Endangered and Sensitive Species Recovery 32
Reference conditions 32
Wildlife 32
Fire hazard 32
Current conditions 33
TES Plants 33
Wildlife 36
Threatened and Endangered Wildlife 36
Special Status Wildlife Species 47
Survey and Manage Wildlife Species 48
Fire Hazard Assessment 48
Suppression Effectiveness 49
Synthesis and interpretation 50
TES Species recovery 50
ISSUE 4 58
Access 58
Reference Conditions 58
Current conditions 58
Synthesis and interpretation 59

CHAPTER 4 63
Recommendations 63
Introduction 63
ISSUE 1: Water Quality 63
A. Water quality and scenic value 63
B. Water and the economy 63
ISSUE 2: Anadromous fish 64
A. Fisheries and the community 64
B. Cooperative restoration 65
ISSUE 3: Threatened, endangered and special-status species recovery 66
A. Late-Successional Reserve improvement 66
B. Ecosystem sustainability 67
C. Fire hazard assessment 68
ISSUE 4: Access 70
A. Consultation with Cahto Tribe 70
B. Fire risk trend 70
C. Recreation Use 71

References 72

Acronym Definitions 74

Appendices

Preface

The South Fork Eel River Watershed Analysis was prepared jointly by staff from the Bureau of Land Management Arcata Resource Area Office, Six Rivers National Forest, and the US Fish and Wildlife Service Arcata Field Office. The watershed analysis process focused on the federally-managed portions of the watershed and actions that federal agencies could undertake for management of the watershed. Only seven percent of the entire watershed is federally-managed lands.

As with many watershed analyses, the narrative in this document focuses on areas for which most information was available. In this case, the BLM lands and the State Park lands are the focus of the document even though about 85 percent of the basin is privately-owned. Very little information was available for private lands.

Watershed analysis is an iterative process with each effort at producing a document hopefully making the process more complete. Given the staff time and other resources committed to this interagency effort was limited, the Watershed Analysis Team decided to produce a document at this time, even though the document contained known deficiencies.

The South Fork Eel River Watershed Analysis does not presently meet the requirements of the ROD for the Northwest Forest Plan in a few specific areas. The Watershed Analysis Team felt it is important to note these specific deficiencies.

- ROD Page C-32, RF-3: "Determine the influence of each road on the Aquatic Conservation Strategy objectives through Watershed Analysis."

At this time, BLM is completing maps of a road history for BLM managed lands in the South Fork Eel River watershed. These maps should be included in the next iteration of the South Fork Eel River Watershed Analysis. The Bureau of Land Management has let a contract for an assessment of all maintained and abandoned roads for BLM lands in the watershed and the final report from this project should be available by June, 1997.

- ROD Page E-4: "Specific to monitoring and evaluation, the results and findings from watershed analysis are used to reveal the most useful indicators for monitoring environmental change, detect magnitude and duration of changes in conditions, formulate and test hypotheses about the caused of the changes, understand these causes and predict impacts, and manage the ecosystem for desired outcomes. Watershed analysis may result in additional monitoring questions. Watershed analysis will provide information about patterns and processes within a watershed and provide information at that scale."

At this time, although this watershed analysis will provide some useful information as well as recommendations for monitoring needs, it does not reveal the most useful indicators for monitoring as described in the ROD. If increased information from private lands becomes available in the future, the ability of a watershed analysis to meet this requirement will improve greatly.

- ROD Page B-13: "Watershed analysis should take into account all species that were intended to be benefitted by the prescribed Riparian Reserve widths. Those species included fish, mollusks, amphibians, lichens, fungi, bryophytes, vascular plants, American marten, red tree voles, bats, marbled murrelets, and northern spotted owls."

Maps of interim Riparian Reserves are not included in this document and thus were not used to analyze the effects of this land allocation on these species. At this time, BLM is completing an assessment of unstable lands which will be included in future maps of interim Riparian Reserves.

CHAPTER 1
Watershed Characterization

Land Status

The South Fork Eel River watershed is part of the Eel River system located on the North Coast of California in Humboldt and Mendocino Counties (Figure 1). The South Fork Eel River watershed covers 440,572 acres with elevations ranging from 100 to 4,500 feet. It contains 713 miles of stream according to USGS maps. About 81 percent of the watershed is under private ownership. It contains approximately 80 percent of the major stream miles (i.e., those with important fish habitat) in the watershed. These private lands have been and are being used for intensive timber harvesting, livestock grazing, and dispersed rural development.

State lands encompass about 12 percent of the South Fork Eel River watershed and are mostly located within the boundaries of Humboldt Redwoods State Park. Bureau of Land Management land comprises the remaining seven percent of the watershed. Together, federal and state lands contain approximately 20 percent of the major stream miles.

The 4,055-acre Angelo Coast Range Preserve is contiguous with BLM land (Figure 2) and contains one of California's largest remaining old-growth Douglas-fir forests, as well as several pristine stream systems. Originally acquired by the Angelo family, The Nature Conservancy established a preserve in 1959 and in 1994 transferred title to the University of California.

The west and east sides of the South Fork sub-basin differ in vegetation, geology, stream size, and fish usage. The west side is predominately vegetated with redwood and Douglas-fir. On the east side there are more oak woodlands and grasslands, with some redwood located lower in the drainage. The larger sub-watersheds are on the northwest and southeast sides of the mainstem.

US Highway 101, the major California coastal highway, is a major thoroughfare that is located adjacent to the South Fork Eel River from its confluence with the mainstem to the community of Legget. Average daily number of vehicles passing Garberville on Highway 101 is 6,400 (California Department of Transportation, unpublished data, 1993). The number of vehicles peaks in July at 8,300 vehicles per day. The levels of water and air pollution generated from this traffic and its effect on the watershed were not analyzed for this document.

Geology

The South Fork Eel River watershed is underlain by two major belts of the Franciscan Assemblage, as well as younger, weakly consolidated sediments, recent stream terrace deposits, and scattered landslide deposits.

> The older, eastern belt (Central Franciscan) is composed primarily of melange containing scattered large blocks of greywacke sandstone and various other lithologies. There is also a large area of ultramafic rock (serpentinized peridotite) around Red Mountain.
>
> The younger, western belt (Coastal Franciscan) is composed of the Yager and Coastal terranes. Both are interbedded greywacke and argillite with minor conglomerate.

The much younger, weakly consolidated Wildcat Group of sedimentary rocks occupies several square miles in the north-central part of the watershed. Landslide deposits also occur throughout the watershed, but are somewhat more common in melange terrain.

Figure 1. Location of South Fork Eel Watershed within Eel Basin, northwestern California.

Scale: 1:1800000

UTM, Zone 10

Map Compiled by GIS Group
Watershed Analysis Center
November 19, 1996

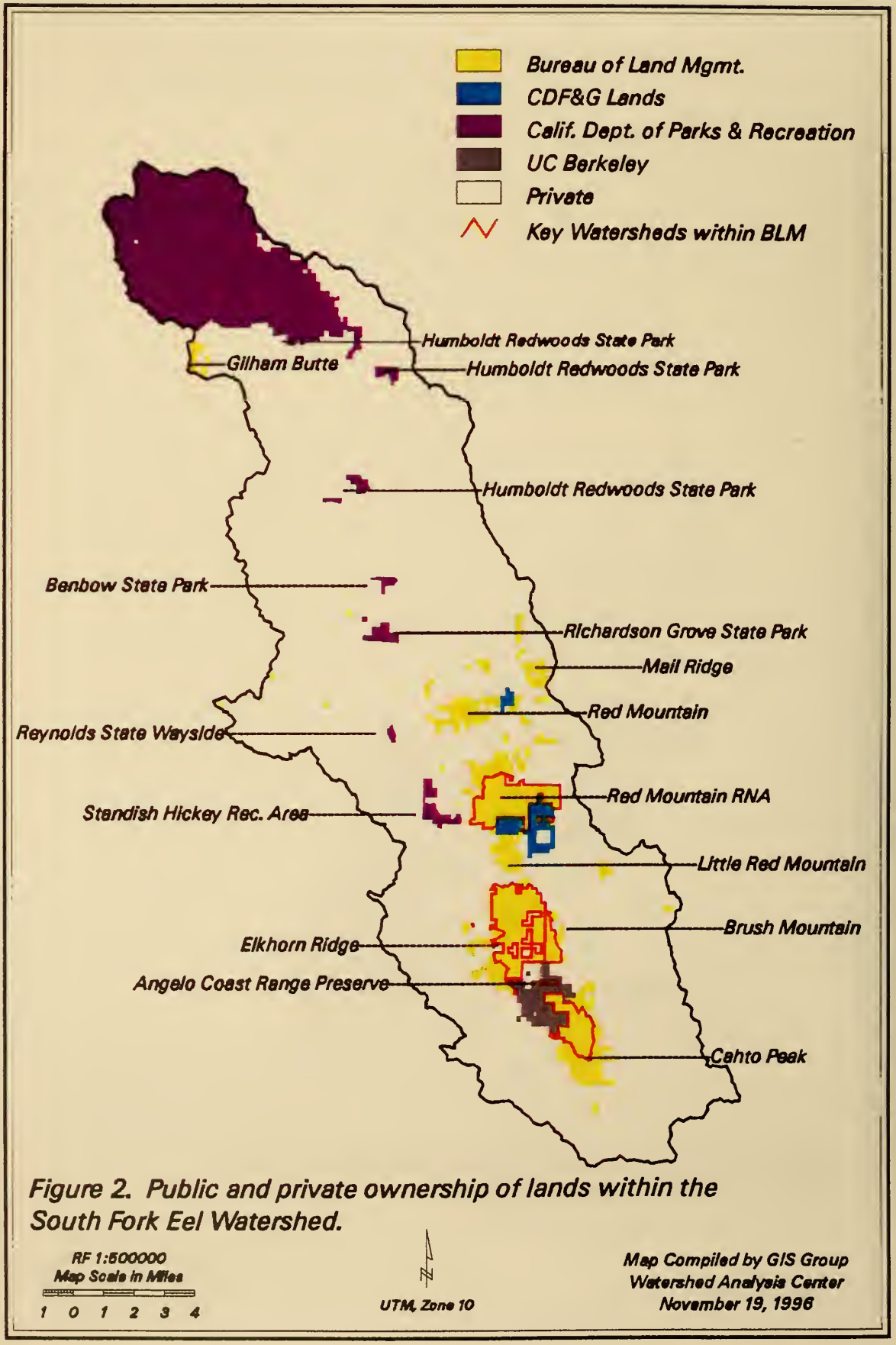


Figure 2. Public and private ownership of lands within the South Fork Eel Watershed.

The South Fork Eel River watershed lies in a region that has been very active tectonically for several million years. Local uplift rates are among the highest in California, and have produced high rates of downcutting, landsliding and sediment delivery to streams for an equally long time. Active faulting has also effected parts of the watershed in the last million years, resulting in well-defined lineaments, shear zones, and offset drainages. Terrain in this watershed is the youngest, geologically, of any part of the Eel River Basin.

Geomorphology: The landscape of the South Fork Eel River watershed is highly variable since it is strongly dependent on the character of the underlying parent material.

Areas underlain by relatively intact greywacke typically have moderately steep, even slopes with moderately deep, forested soils.

Areas underlain by melange usually have gentler, hummocky slopes related to a long history of slump-earthflow activity. More competent blocks are scattered throughout the melange and form rugged knobs in these oak-grassland areas.

Areas underlain by more argillaceous sedimentary rocks are intermediate in character between the other two types.

Areas of ultramafic rock are typically steep and rounded with occasional precipitous cliffs and block-type landslides. They also support distinct soils and vegetation.

Younger alluvial deposits form relatively flat terrain with poorly developed soils.

Development of this landscape has apparently not been a linear, progressive process, but an irregular one, punctuated process of downcutting and quiescence for long intervals.

Stream channels in the South Fork Eel River watershed form a trellis-dendritic pattern; major streams typically follow the general NNW trend of the underlying Franciscan rocks, while secondary drainage has tended to somewhat dissect the terrain across the "structural grain." These two sets of channels also differ in that the major ones commonly form entrenched meanders within older terrace deposits, whereas the secondary tributaries are typically steep, straighter, and entrenched nearly to bedrock with minimal floodplains. This is probably a result of episodic uplift in which a relatively long period of quiescence allowed the main streams to form broad valleys while headwaters continued to downcut, followed by more recent high rates of uplift that is responsible for main stream trenching of the former valleys. Recent trenching has also redistributed older terrace deposits and formed many lower, inset terraces.

Hydrology

The South Fork Eel River watershed has a wide range in annual discharge because of the prevailing Mediterranean climate and the limited groundwater storage capacity of typical overburden in the watershed to maintain summer base flows. Annual precipitation is predominantly rain from October to April. Annual precipitation is generally higher on the west side of the watershed (compared with the east side) and is higher in the northern part of the watershed (compared to the south). The highest annual rainfall averages 115 inches in the headwaters of Bull Creek. The 1964 flood greatly altered stream conditions throughout the watershed by delivering large quantities of sediment via landsliding. Secondary changes persisted for at least a decade from gullying of landslide deposits and the redistribution of sediment stored in terraces.

The only impoundment on the South Fork Eel River is a summer recreational lake at Benbow. There is extraction of water for domestic and agricultural uses during summer months. The total volume of water removal is unknown but it is likely a significant amount during periods of low water flow.

Soils: The South Fork Eel River watershed contains highly variable soils that are typical of soils developed on the suite of Franciscan rocks present. They vary from gravelly sandy loams to heavy clay loams, from relatively shallow on unstable terrain to very deep on long-stable sites, and from well-drained to poorly-drained with higher clay content on melange and argillite substrates. Owing to the comparatively high erosion rates of the basin, most soils are not well developed because their formation has not been much faster than the rate of stripping away by landsliding and surface erosion. Despite this, many soils in the watershed are quite highly productive.

Fisheries

Stream temperatures in the mainstem river and many tributaries approach lethal levels for native fishes during the summer months.

The South Fork Eel River is the most productive major tributary for anadromous fish in the entire Eel River Basin. It has been speculated that the South Fork Eel River watershed once supported about half of the total coho run for the State of California. The South Fork still has a significant population of coho which are among the last remaining wild (non-hatchery), long-run coho salmon in California.

The three principal anadromous fish in the South Fork Eel River are chinook salmon (*Oncorhynchus tshawytscha*), coho salmon (*O.kisutch*), and steelhead (*O.mykiss*). Others include coastal cutthroat trout, green sturgeon, Pacific lamprey, and American shad. The populations of all of these fish have declined in the past several decades because of habitat degradation and elevated water temperatures.

Vegetation

According to the Timberland Task Force (TTF) data the dominant WHR (Wildlife Habitat Relationship) vegetation types in the South Fork Eel River watershed are Montane Hardwood Conifer, Douglas-fir, Redwood, and Montane Hardwood (Table 1). These types correspond to the following CNPS (California Native Plant Society) vegetation series: Douglas-fir-tanoak, Douglas-fir, redwood, and tanoak. Chaparral, grasslands, white oak and black oak woodlands — as well as riparian plant communities (including black cottonwood and alder) — are also components of this watershed.

The distribution of these vegetation types is influenced by climate, parent material and soils, topographic position, and disturbance. A moisture gradient, extending from high moisture in the coast-facing ridges in the west to low moisture in the inland ridges in the east, has a major influence on vegetation patterns in this watershed. The west side of the watershed is dominated by the mesic vegetation types, Montane hardwood conifer or Douglas-fir-tanoak, and redwood. The east side of the watershed is dominated by grasslands, oak woodlands, and Douglas-fir-ponderosa pine stands.

Interpretation of size class and canopy closure information from the TTF data set suggests a majority of this watershed is early- to mid-mature. Sixty percent of the land covered by the TTF data has 60 percent or greater canopy closure and 70 percent of the trees are in size class 11-

23.9" (Table 2). See Appendix A for discussion of the limitations encountered within the TTF data and a comparison between TTF and BLM data.

The two main geologic units influencing the distribution of vegetation in this watershed are the ultramafic rock units and the Franciscan melange. The main block of ultramafic bedrock is found on Red Mountain in the southern end of the watershed. Vegetation on Red Mountain is dominated by open stands of Jeffrey pine, ponderosa pine, incense cedar, and sugar pine, with shrubs such as huckleberry oak (*Quercus vaccinifolia*), dwarf silktassel (*Garrya buxifolia*), and siskiyou mat (*Ceanothus pumilus*) in the understory. Several plant communities are restricted to the Red Mountain area and may warrant special management consideration. These communities include stands of Sargent's cypress (*Cupressus sargentii*), McNab's cypress (*Cupressus mcnabinana*), and two undisturbed bogs. The main block of Franciscan melange extends from the western to the eastern side of the watershed, approximately 35 miles from the confluence of the South Fork Eel River and the Main Eel River. Due to limited moisture availability, this area is dominated by grasslands and oak woodlands with only a few Douglas-fir present.

Table 1. The distribution of Wildlife Habitat Relationship (WHR) vegetation types in the South Fork Eel River watershed. (Note: Not included are the lower 95,000 acres of the watershed - see Appendix A for explanation).

WHR Type	Percent
Barren (BAR)	1.00
Closed pine cypress (CPC)	0.03
Douglas-fir (DFR)	23.00
Herbaceous (HRB)	4.00
Jeffrey pine (JPN)	1.00
Klamath mixed conifer (KMC)	6.00
Montane hardwood conifer (MHC)	45.00
Montane hardwood (MHW)	7.00
Ponderosa pine (PPN)	3.00
Redwood (RDW)	10.00
Shrub (SHR)	1.00
Undetermined (UND)	0.26
Urban (URB)	0.01
Water (WAT)	0.15
White fir (WFR)	0.00

Table 2. The distribution of size classes in the South Fork Eel River watershed. (Note: Does not include the lower 95,000 acres of the watershed).

Size class	Percent
0 = 0-5.9"	6.0
1 = <6.0"	0.07
2 = 6-10.9"	5.0
3 = 11-23.9"	70.0
4 = 24-35.9"	16.0
5 = >36"	4.0

Fire and Floods

Wildfires have been a major component in the formation of western ecosystems, including the South Fork Eel River watershed. As part of a dry terrestrial physiographic province, fire has been the dominant natural disturbance factor (FSEIS 1994). Fire frequencies have been highly variable, and wildfires did not always result in complete stand mortality. Within this watershed, fire frequency studies have recorded average fire intervals of 16 to 52 years for Humboldt Redwoods State Park and 12 years in Douglas-fir/mixed evergreen forests for the Angelo Coast Range Reserve. On the adjacent Mad River Ranger District, it was found that a 12.7-year frequency pattern exists within mixed evergreen forests. Within this heavily traveled watershed, the development of homes, communities, and recreational opportunities intermixed with wildlands increases the probability of ignitions and often forces wildland firefighters to focus on structure protection at the expense of wildland fire suppression.

Fire and flood are the main natural disturbance factors influencing vegetation in this watershed. Chaparral communities (*Arctostaphylos* sp., *Ceanothus* sp., and *Adenostoma fasciculatum*) found on dry, south-facing slopes experience high fire frequencies influential in the establishment of chaparral species. Repeated burning by Native Americans and European settlers maintained grasslands and prairies over the centuries. In addition, repeated burning by Native Americans in tanoak stands maintained a low frequency of conifers in these stands and an increase in the tanoak component for acorn production. Floods have influenced the growth and establishment of riparian communities. Both alder and black cottonwood on the main stem of the South Fork Eel River are re-established after repeated flooding. Redwoods are also able to reproduce effectively after flooding.

Wildlife

The South Fork Eel River watershed supports a variety of wildlife species. Appendix B lists the threatened, endangered, and special status species known or suspected to occur in this watershed. Thirty-five northern spotted owl activity centers, four peregrine falcon eyries, and five marbled murrelet occupied sites are known. Although bald eagles have been observed, no nesting or wintering areas in the watershed are known. The South Fork Eel River watershed lies within

marbled murrelet Zone 1 and contains both northern spotted owl critical habitat and marbled murrelet proposed critical habitat.

Late-successional habitat is limited in the South Fork Eel River watershed and found mostly on the Angelo Coast Range Preserve, State Parks, and BLM lands. Since no large tracts of federal or state land exist in the California Coastal Province, BLM land in the South Fork Eel River watershed is considered of prime importance to protect against isolation and extirpation of spotted owls and other late-successional associated species (Recovery Plan for the Northern Spotted Owl-Draft, USDI 1992). Protection and enhancement of these Late-Successional Reserves (LSRs) are of prime importance and may provide an important long-term nucleus for the recovery of spotted owl populations in this area.

Social

Thirteen communities exist within the South Fork Eel River watershed: Branscomb, Laytonville, Laytonville Rancheria, Cummings, Leggett, Piercy, Whitethorn, Garberville, Redway, Briceland, Phillipsville, Miranda, and Myers Flat. These communities exhibit a wide range of social values and orientations.

River recreation (hunting, swimming, hiking, fishing, and attending cultural events) is a major economic stimulus for these communities. Recreationists use private, State Park, County, and Federal (BLM) facilities.

Water quality is a significant value held by all segments of the various communities. Water quality is a rallying point and is viewed as an economic necessity. Domestic and environmental water quality is viewed as key to achieving economic success.

The watershed's scenic value is utilized extensively by the local communities; by visitors from the San Francisco Bay Area, and by tourists traveling the Redwood Highway or visiting coastal areas. The redwood drive along the river is a significant attraction within the watershed.

The alternative lifestyle (sometimes referred to as the counter-culture or “back-to-the-land” movement),which is prominent in the watershed, is nationally recognized. The values associated with this lifestyle affect watershed management due to the participatory nature of the communities in environmental and political action.

CHAPTER 2
Issues and Key Questions

Background

The issues and key questions for this Watershed Analysis were formed from a process of gathering potential issues and then analyzing those issues in to a short list of what are considered to be the driving issues for federal land management. Issues from the State of the Eel 1995 report were considered, issues from previous BLM public meetings were considered, along with issues brought up in an interagency meeting that included representatives from BLM, US Fish and Wildlife Service, US Forest Service, US Environmental Protection Agency, and the California Department of Fish and Game. Many of the potential issues were found to be inter-related and through discussions among the involved agencies, some potential issues were combined with others to form the final list of four driving issues.

Issue 1: Water quality related to human uses and needs

Issue Statement:

How can management actions on federal lands in the South Fork Eel River watershed help to maintain or improve the flow of "high quality" water in the South Fork Eel River that supports the desired activities of people?

Key Questions:

1. What types of social values and economic activities does the watershed support currently? And what social values and economic activities can it support in the future?
2. How can federal land management support river-based economic development?
3. How much and in what ways do management activities on federal lands play a role in water quantity?
4. What other types of activities occur that influence the watershed and are of value to the communities?

Issue 2: Anadromous fish

Issue Statement:

In what ways can the South Fork Eel River contribute to retaining and ultimately restoring anadromous salmonid stocks in the Eel River Basin?

Key Questions:

1. What is the relative importance of the South Fork Eel River for anadromous salmonid stocks in the Eel River Basin? What is the importance of the federally-managed portions of the South Fork relative to the entire South Fork Eel River?
2. What conditions have contributed to the decline of anadromous salmonids in the South Fork Eel River, and how are land management activities related to this decline?
3. What will be the relative impact on fish habitat after the next flood event (50-year+ recurrence interval) in the South Fork Eel watershed? In the federally-managed portion of the South Fork?

4. Are the Key Watershed "refugia" and "wild" designations of the Elder Creek-to-Low Gap stream section of the South Fork Eel River effective given the mixed ownership of the headwaters?

5. What factors should the Bureau of Land Management consider for watershed rehabilitation activities to maintain or enhance instream habitat?

6. Where are the high priority watershed rehabilitation areas that BLM should consider?

7. How might squawfish (*Ptchocheilus grandis*) [hereafter referred to as *P. grandis*] affect the population of anadromous salmonids in the South Fork Eel River? What activities can agencies undertake to control or mitigate *P. grandis* effects?

8. What activities can agencies undertake to reduce the likelihood of future introductions of exotics?

Issue 3: TES species recovery

Issue Statement:

What is the significance of the South Fork Eel River in sustaining Threatened, Endangered and Special Status (TES) plant and animal species and their habitats, as well as contributing to the recovery of previously more abundant species?

Key Questions:

1. Does adequate habitat exits to maintain viable populations of threatened, endangered and special status species in the South Fork Eel River?

2. What are the current limiting factors for species of concern?

3. What is the significance of the South Fork Eel River in sustaining TES species and their habitat, as well as contributing to recovery of previously more abundant species? What is the role of federal lands in this recovery?

4. What management actions, if any, are needed in the South Fork Eel River watershed to facilitate recovery of, or mimic natural processes essential for, TES species?

5. What factors contribute to the introduction and dispersal of exotic species that are detrimental to TES species within the watershed? What control measures or changes in land management are needed to reduce or eliminate the impact and dispersal of exotics within the watershed?

6. Which of these exotics are control priorities?

7. How fragmented is the South Fork Eel River watersheds' Late-Successional Reserves (LSRs) and what actions are needed to minimize fragmentation?

8. What is the relationship of LSR land in the South Fork Eel River watershed with other nearby LSRs?

9. What is the fire hazard in the South Fork Eel River watershed and what treatments could help to reduce the hazard? Which are the priority areas to treat?

Issue 4: Access

Issue Statement:

What strategy(ies) should the Bureau of Land Management follow in managing access to federal lands in the South Fork Eel River watershed?

Key Questions:

1. What are the principal concerns and opportunities in this watershed for managing public access?
2. What is the trend of fire risk within the South Fork Eel River watershed and what can be done to decrease the number of human-caused fires, especially in terms of access?
3. Can current public access to BLM lands support the public's need for gathering forest products?
4. If BLM increases public access to the "wild" river portion of the South Fork, what are the associated fire risks? What actions could BLM take to reduce fire risks associated with visitors?
5. How can BLM facilitate needs for American Indians to access areas of cultural significance?

CHAPTER 3

Reference Conditions, Current Conditions; Synthesis and Interpretation

ISSUE 1

Water Quality Related to Human Uses and Needs

Issue Statement: How can management actions on federal lands in the South Fork Eel River watershed help to maintain or improve the flow of "high quality" water in the South Fork Eel River that supports the desired activities of people?

Reference conditions

A. Prehistory

Very little watershed-specific climatic or environmental information exists for the South Fork Eel River. Prehistoric and ethnographic information on aboriginal peoples is likewise lacking. Prehistoric information presented here is at the basin level.

Regional pollen studies and paleoclimatic research suggest that the interior regions of the North Coast Ranges have experienced significant shifts in climate during the last 10,000 years. For this reason the environment of the Eel River Basin has not remained static over time. Rather, both the species of plants found within the basin, as well as their distribution across the landscape, have varied over time.

With the arrival of the American Indians in the region sometime between 5,000 and 10,000 years ago, it is likely that human land-use activities (including the use of anthropogenic [human-caused] fire, hunting, and gathering activities, and the establishment of villages and camps) would have begun to influence the dynamics of the basin ecosystem.

Within the three watersheds of the basin subject to this watershed analysis, little research in the prehistory and few formal archaeological investigations have been undertaken. Some excavations and archaeological investigations have occurred within the Middle Fork of the Eel River on the Mendocino National Forest and also adjacent to the basin on the Six Rivers National Forest. Excavations have taken place immediately to the south near Clear Lake and at Pilot Ridge situated just to the northeast of the Van Duzen River watershed. The prehistory of the region remains to be written.

Regional studies suggest that by about 1,000 years ago, with the arrival of the Athabascans (quite possibly possessing new technologies) in northwestern California, population density within the basin increased. During the ethnographic period (the era preceding the historical era) the basin was occupied by a number of aboriginal groups. Within the South Fork Eel River watershed, the Sinkyone and Cahto peoples occupied the watershed. Northwestern California was rich in game, with large runs of salmon and steelhead trout, and plentiful plant resources including bulbs, oak acorns, and seeds. Due to the proliferation of these resources, the population density within the North Coast Ranges equaled, and in some cases surpassed, the population density of agricultural societies in other portions of aboriginal North America.

The southern Athabascans lived in semi-sedentary villages along the major stream courses. They appear to have practiced a subsistence strategy known as the "seasonal round" which involves movement throughout their home territory in order to procure subsistence resources as they become seasonally available. The more inland southern Athabascans may have been slightly more mobile and during the late spring and summer moved into the higher country for extended periods of time.

B. Historic uses

The early history of settlement and homesteading within the South Fork Eel River watershed followed a course similar to that of the Van Duzen River and North Fork Eel River. The region was settled during the late 1850s and 1860s principally by homesteaders and ranchers. By the early 20th century, however, the tanbark industry, along with the completion of the Redwood Highway bringing more tourism, became the dominant economic activities within the watershed. These activities resulted in a significant increase in population and more intensive development within the South Fork Eel River watershed in comparison to the Van Duzen River and North Fork Eel River watersheds. For this reason, the South Fork Eel River watershed has had the most complex land-use history of the three watersheds associated with the Eel River Basin.

During the period from the late-1850s to the 1870s, the portion of the watershed within southern Humboldt County (centered on the Garberville area) was known as the most remote region of Humboldt County. It was linked to the rest of the county by seasonal wagon roads. It was not until 1876 that the Humboldt-Mendocino Wagon Road,was constructed to link Eureka with the Bay Area (a wagon road from Garberville east to Mail Ridge connected with this road). A wagon road also connected Garberville with Briceland and continued to Shelter Cove with a branch connecting to the north with Honeydew and Ferndale. Prior to that time, the principal commercial product (wool) was transported to Shelter Cove for shipment. Finally in 1890, a more direct route, a wagon road connecting southern Humboldt County with Eureka, was constructed.

Further south, in the headwaters region of the South Fork Eel River watershed (in the Long Valley/Cahto Peak region), settlement and land-use activities during the 1800s were similar to those of southern Humboldt County. Most of those who settled in the area maintained subsistence homesteads or became ranchers. Most were sheep ranches of substantial size (numbering in the thousands of acres). A wagon road connected to Long Valley and to the west over the divide to Westport on the coast. Some local products including wool, redwood shakes, poles, and stakes were hauled by wagons to the coast for shipment to the San Francisco Bay Area. Until the completion of the Humboldt-Mendocino Wagon Road in 1876, there was no road connecting the southern and more northerly portions of the watershed. For this reason, the lower portions of the watershed in Humboldt County were economically linked to Eureka and points north, while the southern portions of the watershed (from about Piercy south) were linked to Ukiah and points south.

It was only after the turn-of-the-century that the watershed experienced rapid growth. First, the tanbark industry provided an important economic stimulus from 1900s to about 1920. Harvesting tanbark from tanoak trees (the tannin was used to tan leather) involved killing the trees by stripping them of bark. This activity appears to have been a significant environmental impact in areas where harvesting took place. The industry collapsed after development of synthetic tannin.

Accelerated population growth and intensification of land use activities within the watershed were precipitated by the opening of the Redwood Highway. The slightly longer routing of the highway through the South Fork Eel River watershed was chosen over the Main Eel River corridor due to

the location of the newly-completed rail line connecting Eureka with Willits. This new route provided economical access to the redwood forests and facilitated an increase in the logging of redwoods within the watershed. In addition, with the growth of automobile ownership, the mobility of urban residents increased. Improved roads, particularly the Redwood Highway, led to a significant increase in tourism and commercial development within the watershed. During this period of economic growth, both from logging and tourism, a number of state parks were created along the route.

After World War II, demand for timber dramatically increased, and for the first time, Douglas-fir became a commercially viable commodity. Timber harvesting took place at such a rapid rate that within only about 20 years nearly all of the old-growth Douglas-fir on private lands within the watershed had been logged (and most of the mills were shut down). By the late 1960s, the population within the watershed began to rapidly increase as urban residents began to move to the area as part of what has been termed the "back-to-the-land" or "alternative lifestyle" movement. During this period, many ranches were sold and sub-divided. The most recent economic trend in the watershed, starting in the 1970s, is the illegal cultivation of marijuana, now a major land-use activity.

Current conditions

In 1975, the Bureau of Land Management conducted numerous interviews and completed a report entitled, "Social Values Analysis for the Red Mountain Planning Area." This study is useful as baseline data, against which change in social values can be measured to determine its significance and impact. This study identified "ranching,""small town," and "counterculture" as distinctive lifestyles in the watershed. Primary socio-cultural and economic values included: personal space/privacy, open space, public access, undisturbed lands, brush conversion, rivers and tributaries associated with tourism, timber resources, wildlife, livestock forage, Red Mountain nickel deposits, rare plants and soils, predators (coyotes), and Indian cultural sites.

A. Summary of interview data and description of social groups

In 1995, an analysis of the social communities in the Eel River Basin was undertaken. Individuals from communities within the South Fork Eel River Watershed, as well as individuals with particular interest or responsibility in the watershed, were interviewed using a standardized questionnaire. The data collected from these interviews are summarized in this section.

There are 13 communities within the watershed, all with distinct social perspectives. They are: Myers Flat, Miranda, Phillipsville, Redway, Briceland, Garberville, Whitethorn, Piercy, Leggett, Cummings, Laytonville, Branscomb, and Laytonville Rancheria. Laytonville Rancheria is the home of the Cahto Tribe, a Federally Recognized Tribal Government. Trust rights of the tribe and trust responsibilities of BLM necessitate a formalized government-to-government relationship for consultation on land management activities.

These communities have a deep-rooted history with families going back several generations on the same land. They also have large populations of a newer homesteader who refer to themselves as "back-to-the-landers." Interviews indicated that there is a dual society comprised of native, long-term families, with deep, long-standing traditions, and the newer homesteaders whose values relate their perception of living off the land in a non-resource extractive manner. Both groups are subsistence-oriented, depending on the land for their livelihood. The "back-to-the-land" types have some businesses and are oriented to environmental activism. Many "back-to-the-landers" defined their orientation with the environment in an ecological context, with a

lifestyle perceived as harmonious with the land, while the long-standing families defined their orientation with the environment in terms of their livelihoods. There is tension between these social communities and ecological orientations; currently however, relations are good and have improved in recent years.

The "old-time communities" are linked to tourism, logging, and ranching businesses and view the resources in a utilitarian concept. They view it in a pragmatic way. They do not want anything to happen that would negatively impact the river but they are willing to accept some environmental change for the sake of an economic return.

The alternative lifestyle or "back-to-the-land" population is concerned with the health of the river and is moved toward environmental activism. Their philosophy views environmental preservation, restoration, and conservation, instead of resource extraction, as fundamental to their quality of life. They undertake and promote business and lifestyle choices which do not include traditional resource extraction.

The river, stands of redwoods, and scenery make the area a destination for large numbers of tourists, most of which travel from the San Francisco Bay Area.

The Cahto Tribe are aboriginal users of the watershed and today utilize the resources for traditional hunting, gathering, and ceremonial activities.

The timber industry is a large stakeholder in the watershed. Industrial ownerships are comprised of a large tracts of commercial timber land. The industry provides significant local employment, and the influence of economically-driven land management decisions on the landscape is also significant.

B. Major human uses

1. Small-scale subsistence uses:

gathering of fruits, berries, bay leaves, water cress, wild herbs, roots, nuts, fiber, acorns hunting of deer, bear, feral pigs;

fishing for salmon, trout, steelhead;

domestic water use for drinking and irrigation; and

fuelwood gathering.

2. Botanical uses:

collecting wild plant seeds for commercial sale;

guided wildflower tours and individual wildflower viewing;

free-use gathering of seeds and cones;

collecting of Indian basket-making materials; and,

gathering of yew wood.

3. Special landscape features and special places:

Eel River;

Wild and Scenic River designation;

Cedar Creek Wilderness;

Benbow Lake;

Avenue of the Giants;

State Parks;

Camp St. Michael; and,

Eel Rock to Fort Seward.

4. Current recreation uses:

dispersed camping along the highway where there is access to the river;

fishing;

organized camping in facilities'

hunting for feral pigs and other wildlife;

hiking in the Angelo Coast Range Preserve and within BLM lands;

canoeing;

whitewater rafting;

bird-watching;

photography;

swimming;

backpacking;

sightseeing;

picnicking;

mountain biking;

horseback riding; and,

walking through the parks.

5. Recreation facilities and services:

State Park developed campgrounds;

Camp Ravencliff;

Benbow Lake;

River Guide services;

Drift boat guide services;

Angelo Coast Range Preserve and BLM trails;

Wilderness Lodge; and,

BLM dispersed camp sites.

6. Spiritual and religious uses:

The Cahto Tribe of Laytonville Rancheria places spiritual significance to Cahto Peak and various other locations on BLM lands.

7. Commodity product uses:

Mining claims on Red Mountain;

alternative energy sources;

small-scale family farming;

commercial mushroom harvesting;

small forest products gathering;

hardwood industry;

burl products;

small-scale timber harvesting on private lands;

ranching;

grazing on private and public lands;

large-scale timber production on private commercial lands;

illegal marijuana growing;

land development;

agricultural uses;

water diversions for energy;

furniture making from hardwoods;

commercial firewood;

roadside chainsaw art;

commercial crafts of natural resources;

salves from native plants;

split wood products;

commercial sale of huckleberry products;

commercial sale of conifer cones; and,

dried flowers.

8. Individual lifestyle preferences and expectations:

Environmental integrity was a general sentiment throughout the watershed. The definition of the integrity differed. Nearly all the homes in the hills are owner-built and a lot of people live without electricity. Water sources for these homes are dependent upon springs or diversions of small creeks. Most have outhouses rather than septic systems. People who live this way tend to be rugged and self-reliant individualists. Many of them came to this region to live a simpler life and get back to the land. The ranching and logging industries were the primary economic motivations and lifestyle choices until the mid-1970s. These

lifestyles span generations and embody a view of the land as a partner in their economic survival. Despite vast differences in lifestyles and approaches, natives and "back-to-the-landers" the two communities will come together to improve the health of the river. The river is viewed as a vital link to their lifestyles and economic present and future.

9. Needs for rural economic livelihood:

development of eco-tourism opportunities;

access to BLM lands for primitive recreation experiences;

development of a multi-agency clearinghouse that identifies facilities, locations, special places, trails, roads, campgrounds, etc. to direct the tourist to and direct the development of marketing information about the recreation experience on the South Fork Eel River;

development and improvement of existing campgrounds to include clean water and flush toilets;

improvement of facilities;

Highway 101;

safe roads and trails;

the train system;

telecommunications;

airport;

continued improvement of the Humboldt Bay;

the river and its heath, appearance, and water level;

fisheries restoration in the Eel River overall; and,

river health and restoration as a driving issue in all land management decision-making.

Synthesis and interpretation

The significant social trends within the watershed include the increase of population and the increase of people who are considered living an alternative, or "back-to-the-land" lifestyle. These individuals will continue to invest in businesses ventures and property and will continue their political environmental activism.

Land development and movement from larger cities to this rural area will continue.

Tourism will increase along with the need for river access. There will be increased pressure on the use of current recreation facilities, both public and private, and on the use of water from the South Fork Eel River. This will in turn put more pressure on the land management companies and agencies to assure a healthy and attractive river and river landscape.

There are two critical locations for scenic vistas of the public lands of the South Fork Eel River watershed. They are the old vista point on Highway 101 and the Wild segment of the river. The vista point is located on an extremely unstable slide area on the south slope of Red Mountain. During the winter of 1995-96, the slide destroyed a large section of the road, requiring extensive reconstruction, recontouring, shoring, storing of slide material, and re-paving. California Department of Transportation (CalTrans) did not reconstruct the vista point after repairs were completed. This vista point offered a view down the South Fork Eel River that was

very popular. BLM should work with CalTrans regarding the feasibility of re-establishing this vista point.

Federal land ownership within the watershed is minute in comparison to the total amount of land within the watershed; however, BLM lands include important river areas and mountains. Some of the mountain areas have received intense interest for their very unique values. Red Mountain supports unique botanical resources, and Cahto Peak contains sites of religious and spiritual significance for the Cahto Tribe. Cahto Peak also has a communications site. Water quality and fisheries are important issues both locally and regionally. Restoration of the fisheries in the Eel River in general has active citizen and agency support. Coolness, clarity, and abundance were the water quality parameters identified by residents interviewed.

Most community individuals could not describe where BLM lands were located or what access they had or did not have to these areas. As subdivisions, "homesteading," the numbers of landowners, and the general population continue to increase, the demands on public lands for fuelwood, small forest products, relaxation/recreation, and water will increase.

1. What types of social values and economic activities does the watershed support currently? And what social values and economic activities can it support in the future?

The Eel River and its accompanying landscape continue to play a significant role in the makeup of social and economic values in the watershed communities and, in the future, will be the most significant focal point around which economic development will depend. Tourists are attracted to the area by the river itself, the redwoods, the scenic drive through the redwoods and along the river, the various developed state parks, Benbow Lake, and privately developed recreation facilities. The communities have developed events and activities that draw thousands of people together on the river. For example, there events such as Reggae on the River, Shakespeare on the River, and Jazz on the River. These are annual events which require the cooperation and support of all segments of the communities.

Tourists drive the redwoods section of the highway, often staying in developed campgrounds and other private facilities. Fishing and, to a lesser and more seasonal degree, hunting draw many recreationists to the area.

Interviewees identified the most significant "places" in the watershed. These include the Cedar Creek "Wilderness," Benbow Lake, Avenue of the Giants, the State Parks, Camp St. Michael, and the river reach from Eel Rock to Fort Seward. Many simply identified the Eel River itself as both a special landscape feature and a special place. Most of these places are destinations for tourists, generating stays of more than a day. The economic activity from these support the tourism industry and other related businesses. Garberville has become a center, providing tourists and recreationists with a jumping off point for a variety of experiences, particularly river-based recreation. Business interests recognize the need to promote tourism, develop services and to market experiences which will encourage longer visits throughout the various seasons.

2. How can federal land management support river-based economic development?

There is currently a small amount of recreation use of BLM lands and this use will more than likely increase slightly over time. Whitewater boating occurs in the 15-mile stretch of river flowing through BLM lands. There are currently whitewater and rafting guide services that utilize this area. As access and information about the public lands becomes available, use by residents will likely begin to increase.

BLM lands cannot offer all types of recreation experiences; however, recreation development and management can be aimed at meeting the primitive recreation experience which will enhance the overall recreation opportunities within the watershed as a whole, thereby complementing experiences offered by State Parks and private facilities.

BLM completed the South Fork Eel River Management Plan and Elkhorn Ridge Timber Sale Environmental Impact Statement in 1993 which outline in detail recreational opportunities and management objectives of BLM. The public was very active in participating in and reviewing these documents. BLM identified the ability to contribute to the recreation economy though its rehabilitation and enhancement of fishery habitat and riparian areas, and by addressing erosion issues from roads and skid trails that are contributing to the degradation of aquatic environments. Interviewees also identified these as primary issues.

The river corridor, in the Management Plan, was identified as a Special Recreation Management Area. BLM again identified management objectives that address the issues raised by those interviewed. They will initiate visitor information and education programs aimed at protection of river integrity, private property rights, and overall resource protection.

Visual or landscape views were identified as a high priority by the local businesses and visitors. BLM lands within the river corridor are classified as "Wild" under the Wild and Scenic River designation. BLM's plan identified objectives to meet this public issue which includes protection of the viewshed as seen from along the South Fork Eel River.

3. How much and in what ways do management activities on federal lands play a role in water quality and quantity?

BLM road maintenance, construction, and use play a role in the watershed. Although the roads are designated as administrative, many private inholdings are reached through BLM roads or rights-of-way. Red Mountain parcels are being subdivided down to 40 acres currently, and the trend toward smaller parcel sizes will continue. This results in increased need for access by new roads or through rights-of-way over BLM administrative roads. Roads for rights-of-way to access private timber and/or to access private property for development will continue to increase on those properties surrounded by, or accessible through, BLM lands. The population will continue to increase within the Red Mountain area as further subdivision of 160-acre parcels continues, resulting in increased domestic water demands on springs, creeks, and the river.

The South Fork Eel River watershed contains numerous gated roads which are increasingly added to as the population and development increases. Subdivision of larger acreage into small 40-acre parcels, usually occurring after the parcels have been logged, is a trend is this area as well. Individuals purchasing these parcels are often unfamiliar with road building, restoration of lands after logging, and other maintenance which is resulting in further environmental effects. This trend is not likely to decrease in the near future.

The Bureau of Land Management cannot control these types of activities; however, road construction by BLM for administrative reasons could be analyzed to determine the amount of collateral roads that could be constructed to access private lands and determine if that increase could adversely affect water quantity and/or quality.

4. What other types of activities occur that influence the watershed and are of value of the communities?

The Cahto Tribe uses the hills and ridges to procure resources such as acorns, herbs, fish, and animals. They desire to access BLM lands to gather, hunt, and use cultural and religious locations.

Due to their Federal Recognition, BLM must consult with the Tribe to determine if any Trust responsibilities exist. There is some relationship currently, but it seems to be unsatisfactory for both BLM and Cahto.

Local residents use the South Fork Eel River watershed for a small amount of subsistence gathering, and BLM lands seem to have only a small amount of this use. The primary subsistence activity on BLM lands is deer and feral pig hunting, accessing public lands by the Elkhorn Ridge and Cahto Peak road access. These roads are the only legal public access into BLM lands. Additionally, locals utilize swimming holes, fish, do a limited amount of day-hiking, and utilize day use camps for picnicking along the South Fork Eel River. BLM lands are closed to fishing year round.

ISSUE 2
Anadromous Fish

Issue Statement: In what ways can the South Fork Eel River contribute to retaining and ultimately restoring anadromous salmonid stocks in the Eel River Basin?

Reference conditions

Geology and watershed:

The bedrock underlying the South Fork Eel River watershed was emplaced as a series of thrust sheets "welded" to the North American continent as the Pacific seafloor has been subducted under the continent during the past 150-200 million years. These units consist of marine sediments, as well as some chert and volcanic rocks, that are distributed in elongated NNW-to-SSE belts. More recently, this older terrain was covered by Tertiary sediments (the Wildcat Group) that were weakly consolidated into mudstone, siltstone, and sandstone before being uplifted into their present terrestrial environment and then subjected to erosion.

The South Fork Eel River drainage has changed dramatically during the past few million years as its streams have cut into bedrock units with greatly different resistances to erosion and mass-wasting. The rate of uplift appears to have varied somewhat during this time, resulting in periods of relative quiescence when the main streams were able to meander laterally and develop broad valleys. At other times, uplift rates were high (as at present), and streams downcut vigorously into older alluvial terraces and weaker bedrock units. Downcutting has generally been accompanied by widespread landsliding, typically slump-earthflow processes in melange terrain and debris sliding in other more competent units.

The most recent period of high uplift rates and rapid downcutting does not appear to have affected the entire watershed. Much of the headwaters contain relatively gentle terrain and wide valleys remaining from an earlier cycle. This is a reverse of the "normal" situation in which headwaters are steep and rugged compared to lower reaches. There are a number of nick points migrating up-channel that will gradually encroach on these headwater areas.

In the lower parts of the watershed, debris slide processes have tended to maintain fairly straight, steep slopes in greywacke units of the Coastal and Central belts. In the more argillaceous units and areas of melange, deep-seated landslides, including slump-earthflows, have been the more common type of slope development. This has produced somewhat gentler, irregular topography. The ultramafic terrain around Red Mountain appears to have experienced a combination of deep-seated block slides and debris slides and flows. Aerial photographs reveal much geologic structural control of mid-scale topography; shear zones and faults are evident, often coinciding with landslides.

Like all North Coast watersheds, the South Fork Eel River has experienced a wide range of streamflow conditions in the past several thousand years — from extreme summer low flows to catastrophic floods even greater than the 1964 event. The South Fork Eel River has probably also had a more intense recent seismic history than inland parts of the basin since it is closer to earthquake-producing faults. Together, these natural forces have likely produced infrequent episodes of massive slope failure and sedimentation of stream channels. However, other large but less catastrophic high flows appear to have been sufficient to transport much of this sediment out

of the system. This is also due in part to uplift that has maintained relatively high gradients and stream power.

Fisheries:

The historic population numbers of anadromous runs of native populations are not known. Accounts from early records (see Appendix C) indicate very large populations of salmon that were important to both Native Americans and early European settlers. Records of fish counts at Benbow Dam from the 1930s indicate that there were approximately 20,000 chinook salmon and 15,000-17,000 coho salmon annually returning to South Fork Eel River. The condition of aquatic habitat prior to road building and timber harvesting is also not known. It is assumed that the pools within the mainstem were much deeper than today, for the most part because of lower sediment input. It is also likely that smaller tributaries with roughly north-south orientation that flowed through melange or ultramafic areas with less shielding vegetation would have always had summer water temperatures in the upper 70 and low 80 degrees Fahrenheit due to longer exposure time to the sun.

Current conditions

Geology and watershed:

Seismic activity and occasional floods continue to be a factor influencing current mass-wasting processes in the watershed. They are now superimposed on a landscape that has been greatly disturbed by logging and road construction. This is the case particularly near State Highway 101 with its much larger scale cuts and fills and high levels of maintenance which can increase sediment delivery to streams.

The 1964 Flood had profound effects on slope processes and channel conditions in the South Fork Eel River. It greatly accelerated the delivery of sediment and organic debris to all channels in the lower and middle parts of the watershed (those undergoing the current entrenchment cycle). Rates and magnitude of debris sliding generally increased on lower slopes, and was probably aggravated in some places by road construction and maintenance or logging. Causative relationships are not always clear, however. The trend since the flood has been remobilization and redistribution of flood deposits left in the mainstem and lower tributaries. Bedrock channels have tended to reform in the more competent bedrock sections. Considerable secondary erosion (gullying) and mass failure has occurred in areas of flood caused 1964 landsliding during the ensuing decades and it continues at present.

In a study of Cedar Creek, evidence was presented of a renewed cycle of mass-wasting and accelerated gully development in earthflow terrain as a nick point migrates upstream. However, even with elevated levels of sediment input in the geologically recent past, the streams' capacity to export the sediment has not been exceeded. Therefore, they concluded that Cedar Creek was in rough balance between sediment delivery, transport and storage when the 1964 Flood occurred. They believe that most tributaries have remained in rough balance, but that considerable sediment storage occurred in lower reaches. This material has been gradually "metered" to the South Fork Eel River since 1964.

It is somewhat risky to extrapolate these findings to the watershed as a whole, especially those parts that were intensively managed in the 1950s and 1960s, unlike most of Cedar Creek. Nevertheless, cursory examination of aerial photographs in the central part of the watershed shows a similar pattern of both prehistoric and historic infilling of the lower reaches of tributaries to the South Fork Eel River with deep alluvium. Subsequently, these deposits have

been trenched by tens of feet and the sediment loads have moved into the mainstem. This wave of aggradation is slowly moving downstream, causing localized lateral cutting into sensitive valley walls.

Two areas where this is particularly noticeable are below the confluences of Ten Mile and Rattlesnake Creeks. There is only a moderate level of disturbance and few landslides above Ten Mile Creek where the terrain is gentler with less relief. The mainstem becomes more entrenched with more hillslope disturbance and landslides, as well as much higher sediment levels below the confluence.

The principal existing sediment sources are: (1) slump-earthflow complexes, primarily in melange terrain; there is overall mass movement into channels, as well as debris slides in the toe zone from stream encroachment; (2) scattered debris slides in the various sandstone and argillite units, more commonly in areas of past landslide activity; and, (3) older and more persistent block or debris slides in the ultramafic terrain.

The majority of sediment generated from the watershed during the historic period was probably derived from natural slope-forming processes. Scattered debris slides have occurred primarily on lower- and middle-slope positions in un-managed areas. They seem to be more common on south-facing slopes. A few debris torrents are visible on middle- to upper-slopes. These processes were clearly accelerated locally by human disturbance of sensitive slopes. There is not a clear causal relationship between increased landsliding and upslope logging practices; logging may have increased the upslope extent of slides initiated at the base of the slope, however. Logging seems to have had a greater effect on rilling, gullying, and surface erosion in these particular soils. On the other hand, the effects of road construction and maintenance (or lack thereof) on increased sediment delivery are much clearer. Slope failures are very common on lower slopes in managed areas, particularly those associated with roads. Crossing failures may be closely related to higher runoff and greater organic debris loads from logged areas.

Fisheries:

A severe downward trend in number of anadromous fish can be seen in records of the Benbow Dam fish counts conducted by the Department of Fish and Game from the 1930s to 1976. They show an apparent decline in salmonid stocks to approximately 20 percent of the numbers counted in the 1930s. It is estimated that about 1,000 adult coho salmon still return annually to the South Fork Eel River watershed. The National Marine Fisheries Service has proposed coho salmon in the Eel River Basin (and elsewhere in California and Oregon) for listing as "threatened" under the federal Endangered Species Act (NMFS, 1995).

A four-year study conducted from 1986 to 1989 found the following species to inhabit the South Fork Eel River: rainbow and steelhead trout, California roach, Sacramento sucker, Sacramento *Ptchocheilus grandis*, threespine stickleback, prickly sculpin, Pacific lamprey, coast range sculpin, green sunfish, and coho salmon (Brown and Moyle, 1990). Of these fish, the California roach, Sacramento *Ptchocheilus grandis*, and green sunfish were introduced illegally into the system. Chum salmon and green sturgeon have also been observed in the South Fork Eel River.

There are insufficient data to thoroughly assess the current condition of habitat in the South Fork Eel River watershed; however, some obvious statements can be made for the Eel River watershed as a whole. The lengthy history of land management practices (including road building, logging, and rural development), in combination with flood events in 1955 and 1964, has caused considerable impact to sediment loads and greatly impacted fish habitat. It has been estimated that an average 10-20 meters of sediment were deposited in the South Fork Eel River in 1964 (Lisle,

1982). Current watershed conditions, especially the density of roads, leave the basin at risk of further impacts to fish habitat when another large flood event occurs. However some sub-watersheds contain better fish habitat than others. Those sub-watersheds with less roads, or where roads are well-designed and maintained, can be expected to suffer less impacts from the next large flood and thus may offer refugia of better fish habitat within the South Fork Eel River watershed. The BLM Key Watersheds of South Fork Eel River from Elder Creek to Low Gap Creek and the Cedar Creek watershed are expected to retain high quality fish habitat and water quality conditions due to the nature of the watersheds and the low road densities.

Water temperature is the most important abiotic factor to the survival and production of anadromous salmonids. Little comparable data is currently available on water temperatures throughout the watershed (however a project is currently underway to collect these data for the entire Eel River Basin). The data that is currently available shows summer water temperatures higher than the preferred ranges for all fishes native to the watershed in some areas of the watershed. Past and current land management in the watershed likely contributed to water temperature elevation. Analysis of basin-scale water temperature data is needed.

Sacramento *P. grandis* , a species not native to the Eel River Basin, invaded the South Fork Eel River watershed during the 1980s and has extended its range upstream past Rattlesnake Creek (Brown and Moyle, 1991). Much concern has been raised by the California Department of Fish and Game and by local sport fishing interests regarding the impacts of this predatory fish on the populations of native salmonids. Despite this concern, the impacts of this species is not clear and many questions remain. Several population control measures for *Ptchocheilus grandis* have been undertaken by the California Department of Fish and Game as well as local sport fish interests. The impacts of these efforts are not clear.

Synthesis and interpretation

1. What is the relative importance of the South Fork Eel River for anadromous salmonid stocks in the Eel River Basin? What is the importance of the federally-managed portions of the South Fork relative to the entire South Fork Eel River?

The South Fork Eel River is the second largest sub-basin in the Eel River Basin and is considered to be the most productive sub-basin for anadromous fish (State of the Eel 1995). The west side of the watershed has better habitat for salmonids than the east side due to the size of the tributaries, the surrounding slope vegetation that provides more canopy, and the less direct afternoon sun exposure. The main exception is Cedar Creek which is an east-side tributary. Sproul, Redwood, Indian, and Hollow Tree Creeks are important coho streams with relatively good habitat conditions.

From the Leggett Valley to the headwaters near Branscomb (approximately 30 stream miles), habitat is good for steelhead spawning and rearing. This section includes most of the BLM land in the watershed. Bureau of Land Management lands west of Highway 101 contain headwater tributaries of major streams that provide cooler water to the South Fork Eel River and some salmonid habitat. It is important to maintain these headwater salmonid streams.

2. What conditions have contributed to the decline of anadromous salmonids in the South Fork Eel River, and how are land management activities related to this decline?

Most of the drainage has been heavily logged, generally since World War II. With the development of heavy machinery during the war, logging of previously inaccessible, steep, erodible slopes

became possible. The resulting exposure of the soils and slopes to record rainfalls in 1955 and 1964 caused massive flooding, landsliding, and erosion in the drainage. Aggradation of as much as 10-20 meters was measured in the main channels (Lisle, 1982). Channels have shown some recovery from the events, but parts of the watershed are still eroding at accelerated rates. Anadromous fish runs declined precipitously following the 1964 flood and they have not recovered (CDFG unpublished data; Lufkin, 1991).

The State of the Eel 1995 report states that a substantial part of the South Fork Eel River watershed has been subdivided from timber and ranch lands into smaller parcels used for home development which has increased the miles and use of roads in the watershed. Residents developing homesites have often used old logging and ranching roads for access to their property. Sometimes residents have used old skid roads as driveways and old landings for homesites. Impacts to fish from these roads come from two sources: (1) chronic erosion of fine-grained material during winter rainstorms that reduce the survival of fish eggs; and (2) catastrophic failure of road prisms during heavy storms that cause loss of habitat for summer rearing.

Many of these roads were built for temporary logging use and were not designed for long-term use. Many other roads have been recently constructed to afford access to subdivided parcels, often without proper design. Typically, road drainage is poorly designed, resulting in chronic problems that require frequent maintenance. Sometimes landowners who share a common road form agreements for road maintenance. However, road maintenance requires the use of heavy equipment which may be too expensive for some residents to afford. Regulations are in place for road grading, but these regulations are not enforced and few people are aware of them. In addition, pollutants such as gasoline, oil, and radiator fluid leak onto road surfaces and can be washed into streams (State of the Eel 1995).

Other conditions which have contributed or continue to contribute to the decline of anadromous salmonids in the South Fork Eel River are:

The inherently unstable and/or erodible geology of the area, especially the eastern part of the watershed underlain largely by melange;

Lack of instream cover, large and small woody debris, and other features related to pool development; limited spawning gravel; and unstable streambanks;

Increased withdrawals of water for human use (i.e., irrigation, storage in ponds, etc.) over the years of water development; and,

Commercial and recreational fishing.

3. What will be the relative impact on fish habitat after the next major flood event (50-year+ recurrence interval) in the South Fork Eel River? In the federally-managed portion of the South Fork?

The relative impact of the next large flood event on fish habitat will probably be greater than what followed the 1964 event. Increased impacts to the fishery are likely to come from residual sites from the 1955 and 1964 events which have not fully healed. There are also more roads and cutover lands than existed in 1964, as well as unstable lands which did not fail in 1964, but may have been weakened by that storm/flood or subsequent high rainfall years.

It is difficult to estimate what the relative impacts from private and BLM lands are likely to be, primarily because there are no adequate inventories of relevant conditions on these lands (e.g., road surface conditions, drainage structure integrity, diversion potential, extent of revegetation,

and others). However, given the rough distribution of landslides during the 1964 event, it seems reasonable to expect greater landsliding and sedimentation from the private lands that have experienced substantially more logging and roading than the federal lands.

4. Are the Key Watershed "refugia" and "wild" designations of the Elder Creek-to-Low Gap stream section of the South Fork Eel River effective given the mixed ownership of the headwaters?

Although the mixed ownership lands in the headwaters of the South Fork Eel River above Elder Creek have been logged heavily and numerous roads, skid trails, and landings exist, most of that management has occurred on relatively stable geology and only moderately steep terrain. Generally speaking, landsliding processes on these slopes and soils is less frequent and of lesser magnitude than in other parts of the South Fork Eel River watershed. However, since this area has been logged more recently, it has not been tested under conditions of a 1964-magnitude flood. The stream section between Elder Creek and Low Gap is steep and has a high percentage of inner gorge. These conditions probably promote the continual flushing of sediment. Based on these factors, the "wild," "refugia," and Key Watershed designations may well be effective for anadromous fish, at least in terms of providing important summer rearing habitat. The Key Watershed portion of watershed, given its steepness, may not provide adequate spawning habitat compared to the more gentle terrain found in the headwaters. Further analysis of available spawning habitat availability and condition should be conducted.

5. What factors should the Bureau of Land Management consider for watershed rehabilitation activities to maintain or enhance instream habitat?

The most important factors in this watershed for prioritizing rehabilitation activities are as follows:

> What are the geologic and geomorphic terrain, and what are their relative potentials to mobilize and deliver sediment?
>
> How can the management activity contribute to maintaining or lowering stream water temperatures?
>
> Emphasis upon the following sources of stream sedimentation: stream crossings, landslides, and bank erosion.
>
> Likely cost-effective actions include: improved road construction/reconstruction, upgrading road surfacing where the roadbed is visibly eroding, re-sizing culverts to handle water and debris load, berm placement to avoid erosion of sensitive fill slopes, and maintaining or adding inboard ditches where outsloping is impractical.

6. Where are the high priority watershed rehabilitation areas that BLM should consider?

BLM manages a large fraction of Cedar Creek within the Red Mountain Management Area. Although some restoration activities within the Cedar Creek channel could be beneficial, work sites are not readily accessible.

The Key Watershed of the South Fork Eel between Elder Creek and Low Gap Creek should be considered a high priority of watershed rehabilitation efforts. Abandoned roads should be targets for restoration.

7. How might *P. Grandis* affect the populations of anadromous salmonids in the South Fork Eel River? What activities can agencies undertake to control or mitigate *P. Grandis* effects?

Many ecological relationships could be discussed as an answer to this question. For the purposes of this document, the answer will be confined to the basic interactions of predation and competition.

Throughout the United States, *P. grandis* have a reputation for consuming juvenile salmonids. Importantly, many of the areas where this process has received the most attention include human-built control structures and hatchery releases of salmonids (both the Red Bluff Diversion Dam on the Sacramento River and the lower Columbia River Dams are examples). *P. Grandis* are native to many drainages in the west and have not prevented the existence of large populations of salmonids to occur. Studies of *P. grandis* food habits from areas that were less altered by humans suggest low levels of predation on salmonids. Considering the intricacies of predator/prey interactions, however, previous studies cannot be relied upon to provide an accurate prediction of the consumption of salmonids by *P. grandis* in the novel situations in the Eel River.

In an ongoing study for the Eel River being conducted by researchers at the U.S. Forest Service Pacific Southwest Research Station, salmonids comprised approximately 15 percent (by biomass) of the diet of about 900 *P. grandis* captured over a two-year period (1995-96). Salmonids are consumed when available, particularly during the spring migration of juveniles. This study has found California roach and suckers to be important elements of the *P. grandis* diet in the South Fork Eel River throughout the year. From the available information, it is unclear if *P. grandis* predation on salmonids has the potential to regulate the salmonid population size.

Salmonids and *P. grandis* compete for many of the same food resources. *P. grandis* and steelhead juveniles co-occur in many South Fork Eel River tributaries and over a large portion of the upper South Fork Eel River. The areas of greatest overlap are reaches where the water temperatures are near the upper limit of tolerance for steelhead. From the information available it its difficult to draw conclusions of what effect the addition of *P. grandis* as a potential competitor for food resources may have on the population of salmonids in the South Fork Eel River.

8. What activities can agencies undertake to reduce the likelihood of future introductions of exotics?

Environmental education programs or public outreach programs could be set up to raise public awareness about the effects that exotic plants and animals have on the local flora and fauna, as well as the ecology of the plants and processes.

Assistance could be provided or offered to landowners for proper screen placement, design, monitoring, or consultation.

Planting of fish, plants, or other aquatic species must be carefully regulated. Monitoring of screens and water developments should be done on a regular basis by appropriate agencies.

Measures that promote greater water flow and cooler water temperatures will benefit native salmonids and other native species adapted to the historic conditions of the Eel River and may create less habitable environment for introduced exotic species.

ISSUE 3

Threatened, Endangered and Sensitive Species Recovery

Issue Statement: What is the significance of the South Fork of the Eel River in sustaining Threatened, Endangered and Special Status (TES) plant and animal species and their habitats, as well as contributing to the recovery of previously more abundant species?

Reference conditions

Wildlife

Historically, considerable evidence exists that American Indians were dependent upon black-tailed deer and salmon. Grizzly bear and Roosevelt elk were known to occur in neighboring watersheds and are likely to have ranged into the South Fork Eel River watershed where suitable habitat occurred. Although records exist of extensive deer hunting for hides in the Eel River Basin, it is unclear if the South Fork Eel Watershed contributed significantly to the supply of deer.

Given place names like Elk Mountain and Elk Prairie, Roosevelt elk probably historically used prairies and burned or cut over areas in the northern end of this watershed.

Wildlife predators became a concern for settlers in the early 1900s, especially on sheep ranges. Predator control laws were passed in the early 1900s, with bounties on both coyotes and mountain lions. The bounties were in effect through the 1960s, and USFWS Animal Damage Control (ADC) trappers were hired to trap or poison coyotes in an effort to reduce or eliminate livestock losses.

Little is known about historic levels of peregrine falcon, bald eagle, spotted owl or marbled murrelet distribution and abundance. The historically abundant anadromous fisheries and deer populations could have supported a few breeding bald eagles in the South Fork Eel River watershed. Deer reportedly occurred historically in greater numbers within the hardwood series than they do today. However, in the forest lands, timber harvest generally has resulted in increased numbers of deer browsing on the herbaceous forage in the cut over area. Spotted owl populations probably were higher before extensive timber harvest eliminated most of the late-successional habitat throughout the Eel River Basin. Fire suppression has allowed the ingrowth of understory hardwoods into conifer stands, thus reducing the suitability of these stands for nesting and foraging habitat. It also is likely that marbled murrelets occurred in larger numbers and distribution within the South Fork Eel River watershed, particularly in the northern portion near the confluence with the mainstem, where large old-growth redwood stands were common.

The red-legged frog was reported to occur on several tributaries to the South Fork Eel River and may have occurred in greater numbers before the introduction and subsequent invasion of the bullfrog. While the bullfrog was introduced into farm ponds in the Eel River Basin in the early 1900s, it had only recently invaded the Angelo Coast Range Preserve (Kupferberg, 1995) and the population appears to be increasing.

Fire hazard

Fire will play an important long-term role in recovery of TES Species. Reference hazard conditions can be inferred from several factors. Numerous studies throughout the western United States have indicated that aggressive fire suppression in the 20th century has resulted in stands that are more dense with a greater ladder component. The fire frequencies for this area indicate

that fires have played a major role in the ecological development of major species within the watershed. Without fire suppression the more frequent fires (either from lightning or Native American burning) would have been less intense, but possibly larger in size due to more open canopies. Therefore, rates-of-spread may have still been high under late summer conditions, but flamelengths would probably have been much less severe, except during stand- replacing fire events (under severe weather conditions).

Current conditions

TES Plants

Table 3 lists the threatened, endangered, proposed and special status species in the South Fork Eel River watershed. Some of these plants are found only on private land while others are exclusive to certain areas on public land. Private lands support beaked tracyina (*Tracyina rostrata*) and leafy reed grass (*Calamagrostis foliosa*). Potential habitat exists for beaked tracyina on BLM land but no occurrences of this species have been detected. McDonald's rockcress (*Arabis macdonaldiana*), Red Mountain catchfly (*Silene campanulata* ssp. *campanulata*), and Red Mountain stonecrop (*Sedum eastwoodia*) are found exclusively on ultramafic parent material on Red Mountain within the jurisdiction of the BLM. Potential habitat for Tracy's sanicle (*Sanicula tracyi*) is also found on BLM land. Intensive surveys would more than likely detect this species.

The coral fungi (*Rumaria gelatiniaurantia)*, a ROD species, is found in the South Fork Eel River watershed. Seven non-vascular (lichen and fungi) ROD species also have been recently identified on BLM land in this watershed (Table 3).

Table 3 THREATENED, ENDANGERED, PROPOSED AND SPECIAL STATUS SPECIES IN THE EEL RIVER BASIN
December 19, 1995

Special Status Species include USFWS Candidate species, Species of Concern (SC)[1]; FS Sensitive Species (FSS)[2]; California Native Plant Society 1B Plant Species (CNPS 1B)[3]; Protection Buffer and Survey and Manage Species listed in the Record of Decision (ROD)

K=Known occurrence S=Suspected occurrence E=believed extirpated ?=surveys needed =nesting/breeding

Common Name	Scientific Name	Status	Basin
McDonald's rockcress	Arabis macdonaldiana	FE,FSS	S.Fork,K
Humboldt Bay wallflower	Erysimum menziesii ssp. eurekense	FE	Delta,K
water howellia	Howellia aquatilis	PT	M.Fork ?
Raiche's manzanita	Arctostaphylos stanfordiana ssp. raichei	SC	Middle,K
Humboldt milk vetch	Astragalus agnicidus	SC,FSS	S.Fork,K
leafy reed grass	Calamagrostis foliosa	FSS	S.Fork,K
Humboldt Bay owl's clover	Castilleja ambigua ssp. humboldtensis	SC	Delta,K
Mendocino coast indian paintbrush	Castilleja mendocinensis	SC	S.Fork,?
Pt. Reyes bird's beak	Cordylanthus maritimus ssp. palustris	SC	Delta,K
clustered lady's-slipper	Cypripedium fasciculatum	SC, ROD	V.Duc,K, Middle Fk,K
mountain's lady's-slipper	Cypripedium montanum	ROD	Main,K V.Duc,K Middle Fk,K
Snow Mtn. willowherb	Epilobium nivium	FSS, SC	Main,K,Mid,K
Oregon fireweed	Epilobium oreganum	SC,FSS	Main,? V.Duc,?
Brandegee's eriastrum	Eriastrum brandegeae	SC,FSS	Main,?
Kellogg's buckwheat	Eriogonum kelloggii	SC	S.Fork,K
Snow Mtn. buckwheat	Eriogonum nervulosum	SC,FSS	Main,K,Upper,K
Mendocino gentian	Gentiana setigera	SC	S.Fork,?
glandular western flax	Hesperolinon adenophyllum	SC,	Main,K
drymaria-like western flax	Hesperolinon drymariodes	SC,FSS	Main,K
two-flowered pea	Lathyrus biflorus	SC,FSS	V.Duc,K
beach layia	Layia carnosa	FE	Delta,K
western lily	Lilium occidentale	PE	Delta,K
Anthony Peak lupine	Lupinus antoninus	SC,FSS	Main,K Mid,K
Lassics lupine	Lupinus constancei	SC,FSS	V.Duc,K
Milo Baker's lupine	Lupinus milo-bakeri	SC,	Main,K
Lassics sandwort	Minuartia decumbens	SC,FSS	V.Duc,K
scabrid raillardella	Raillardiopsis scabrida	FSS	V.Duc,K,Main,K, M.Fork,K

coral fungi	Ramaria gelatiniaurantia	ROD	S.Fork,K
bryophyte	Orthodontium gracile	ROD	Main,K
Tracy's sanicle	Sanicula tracyi	SC,FSS	V.Duz,K, N. Fork,K, Main,K
Red Mtn. stonecrop	Sedum eastwoodia	SC	S.Fork,K
pale yellow stonecrop	Sedum laxum ssp. flavidum	FSS	V.Duz,K, N. Fork,K, Main,K
Red Mtn. catchfly	Silene campanulata ssp. ssp. campanulata	SC	S.Fork,K
Kneeland pennycress	Thaspi californicum	SC,FSS	V.Duz,K
beaked tracyina	Tracyina rostrata	FSS	Main,K S.Fork,K

[1] Species of concern are those species formerly listed as USFWS Category 2 Candidate species.

[2] FSS, for plants only, includes membership on the Sensitive Plant Lists maintained by the Six Rivers, Shasta-Trinity, or Mendocino National Forests.

[3] CNPS 1B plants are those that are rare throughout their range. Most Forest Sensitive Plants include CNPS 1B plants.

Wildlife

The threatened, endangered proposed and special status wildlife species known or suspected to occur in the Eel River Basin are listed in Appendix B. Special Status species include Forest Service Sensitive species, Species of Concern (formerly USFWS Category 2 Candidates), Protection Buffer and Survey and Manage species listed in the FSEIS ROD. No USFWS Candidate wildlife species are known to occur in the Eel River Basin.

Threatened and Endangered Wildlife

The South Fork Eel River watershed provides essential habitat for the peregrine falcon, bald eagle, spotted owl, and marbled murrelet, and contributes to their recovery. Although the historical abundance and distribution of these species are not known, timber harvest and fire suppression have altered the relative amount and distribution of forest successional stages, in particular reducing and fragmenting late-successional forests and increasing the growth of understory hardwoods.

1. Peregrine Falcon

Peregrine falcon habitat on BLM land in the South Fork Eel River watershed is being managed consistent with the Pacific States Peregrine Falcon Recovery Plan. The watershed occurs within the California North Interior Recovery Zone which has exceeded its population goals.

Peregrine falcons are known to nest at four locations within the South Fork Eel River watershed but other territories probably occur on private land. Several cliff sites appear suitable for nesting although they are unoccupied at this time. The nesting cliffs for two pairs occur on land owned by CDFG within 0.25 miles of BLM land. A third territory exists on private land directly bordering BLM acreage. Land acquisition of 560 acres exclusively for the protection and management of this territory are a high priority for BLM (BLM Arcata Resource Area 1995). The fourth territory also occurs on private land within one mile of a small 40-acre BLM parcel, and within three miles of larger BLM acreage. Additional acquisition of 1,160 acres is proposed for various resource values, including protection of falcon habitat near the nesting cliffs owned by CDFG.

2. Bald Eagle

No known bald eagle nests or permanent wintering areas occur within the South Fork Eel River watershed although incidental sightings are not uncommon. Immature bald eagles were observed in late March, 1996, near Benbow State Park, and up to five bald eagles have been known to winter on Sproul Creek. Eagle wintering areas on the Eel River change annually depending on food availability, and winter concentrations are not known to exceed ten individuals (Detrich, pers. comm.).

3. TTF Data

The two vegetation data sets available for the watershed analysis were the Timberland Task Force (TTF) and the BLM Arcata Resource Area WHR vegetation types (BLM). The only data available for the entire South Fork Eel River watershed was the TTF data which has apparently numerous limitations (see discussion and comparison in Appendix A). Briefly, TTF appears to over-estimate remnant old-growth stands, and does not reliably represent size class, canopy closure, or species/series. We have used TTF, obviously with reservation, to give an approximate indication of spotted owl habitat in the northern three-fourths of the watershed (345,014 acres), but with the caveat that this data probably inflates the actual amount of habitat. The

southern 22 percent (95,565 acres) of the watershed is below a LANDSAT image edge and totally misrepresented in the TTF data (see Appendix A for further explanation) and thus is considered unusable.

The Bureau of Land Management used existing type maps based on timber management parameters and aerial photographs to develop a Wildlife Habitat Relationships data set and loaded it into a GIS database to serve as the foundation for habitat analysis on their lands. We have used BLM data to analyze spotted owl and marbled murrelet habitat on BLM land. Limitations include a very fragmented picture of the landscape, little correlation between BLM data and TTF data (see Appendix A), and an apparent under-representation of old-growth habitat.

4. Northern Spotted Owl

Suitable habitat for northern spotted owls (NSO) is defined as habitat which supports nesting, roosting (NR), and nesting, roosting, foraging (NRF) activities. TTF data were used to determine what percentage of the watershed contained suitable NSO habitat. Acres of NR and NRF habitat were queried using any series which contained at least 50 percent conifers with trees at least 23.6 quadratic mean diameter (QMD) and 60 percent canopy cover for NR habitat; and at least 18 QMD and 40 percent canopy cover for NRF habitat. According to TTF data, approximately 19 percent of the northern portion of the South Fork is NR habitat (Figure 3) and approximately 37 percent is NRF habitat (Figure 4).

Acres of suitable nesting/roosting habitat (NR) on BLM land was queried using the Douglas-fir, and mixed conifer series which contained trees at least 24-inches diameter at breast height (d.b.h.), with at least 40 percent canopy cover; and the hardwood series which contained trees at least 11-inches d.b.h. and 40 percent canopy cover (BLM). BLM has not defined foraging habitat on the land they manage. Ten percent (3,623 acres) of BLM land in the South Fork Eel River watershed is NR habitat (Figure 4). Table 4 breaks out NR habitat on BLM land by NW Forest Plan land allocations and vegetation series. Eighty-five percent of the NR habitat on BLM land occurs in Late-Successional Reserves (LSRs). The majority of the 548 acres of NR habitat in the Matrix occurs in small fragmented parcels of 40- to 120-acre size. Determination of suitability did not consider patch size or spatial arrangement.

Table 4. The Northwest Forest Plan land allocations and vegetation series of northern spotted owl nesting/roosting habitat on BLM land in the South Fork Eel River watershed.

	LSR (acres)	Matrix (acres)
Douglas-fir	1,950	249
Hardwood	1,097	299
Mixed conifer	27	0
TOTAL	3,074 acres	548 acres

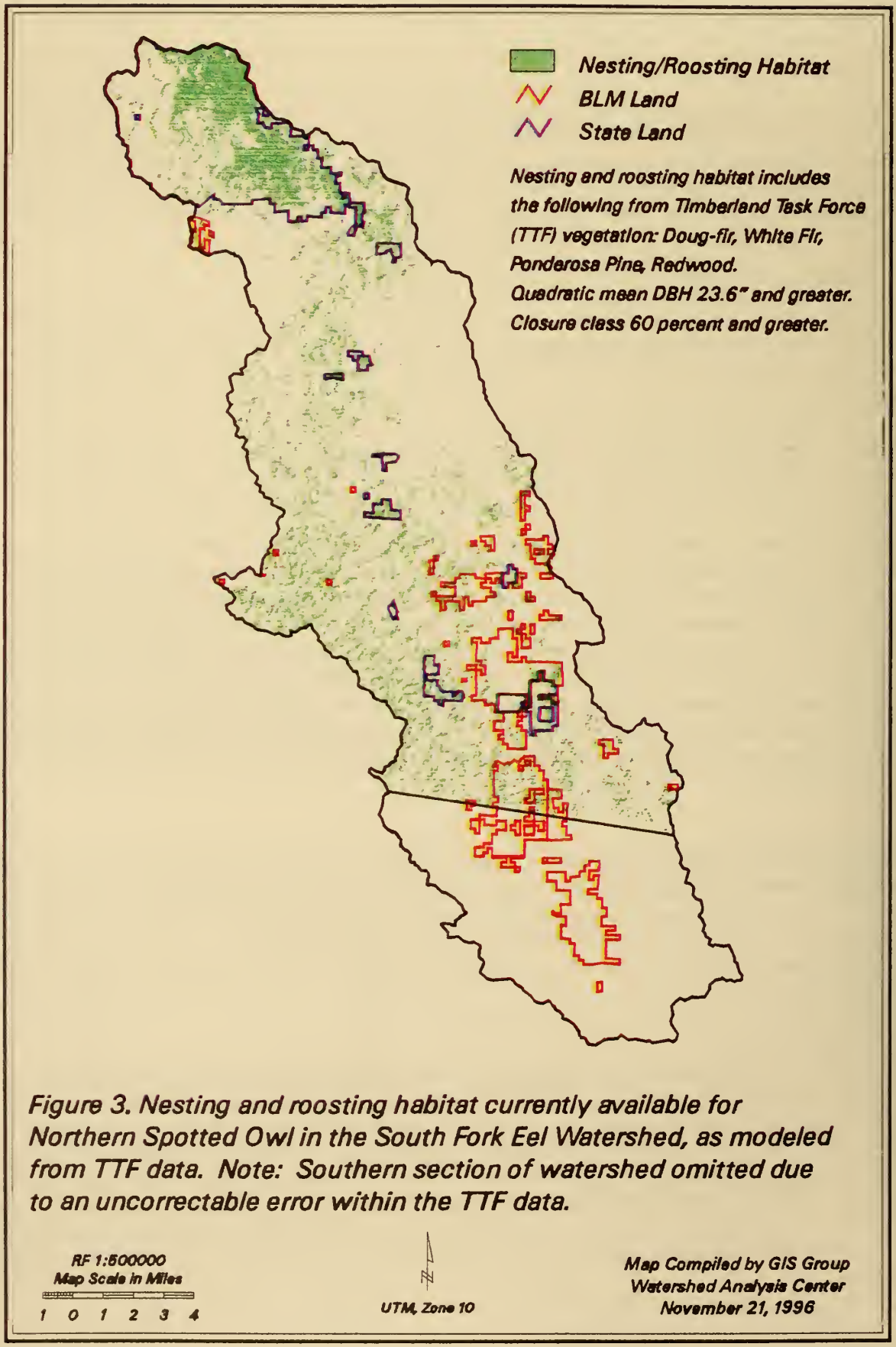

Nesting/Roosting Habitat
BLM Land
State Land
Nesting and roosting habitat includes the following from Timberland Task Force (TTF) vegetation: Doug-fir, White Fir, Ponderosa Pine, Redwood.
Quadratic mean DBH 23.6" and greater.
Closure class 60 percent and greater.
RF 1:600000
Map Scale in Miles
1 0 1 2 3 4
UTM, Zone 10
Map Compiled by GIS Group
Watershed Analysis Center
November 21, 1996

Figure 3. Nesting and roosting habitat currently available for Northern Spotted Owl in the South Fork Eel Watershed, as modeled from TTF data. Note: Southern section of watershed omitted due to an uncorrectable error within the TTF data.

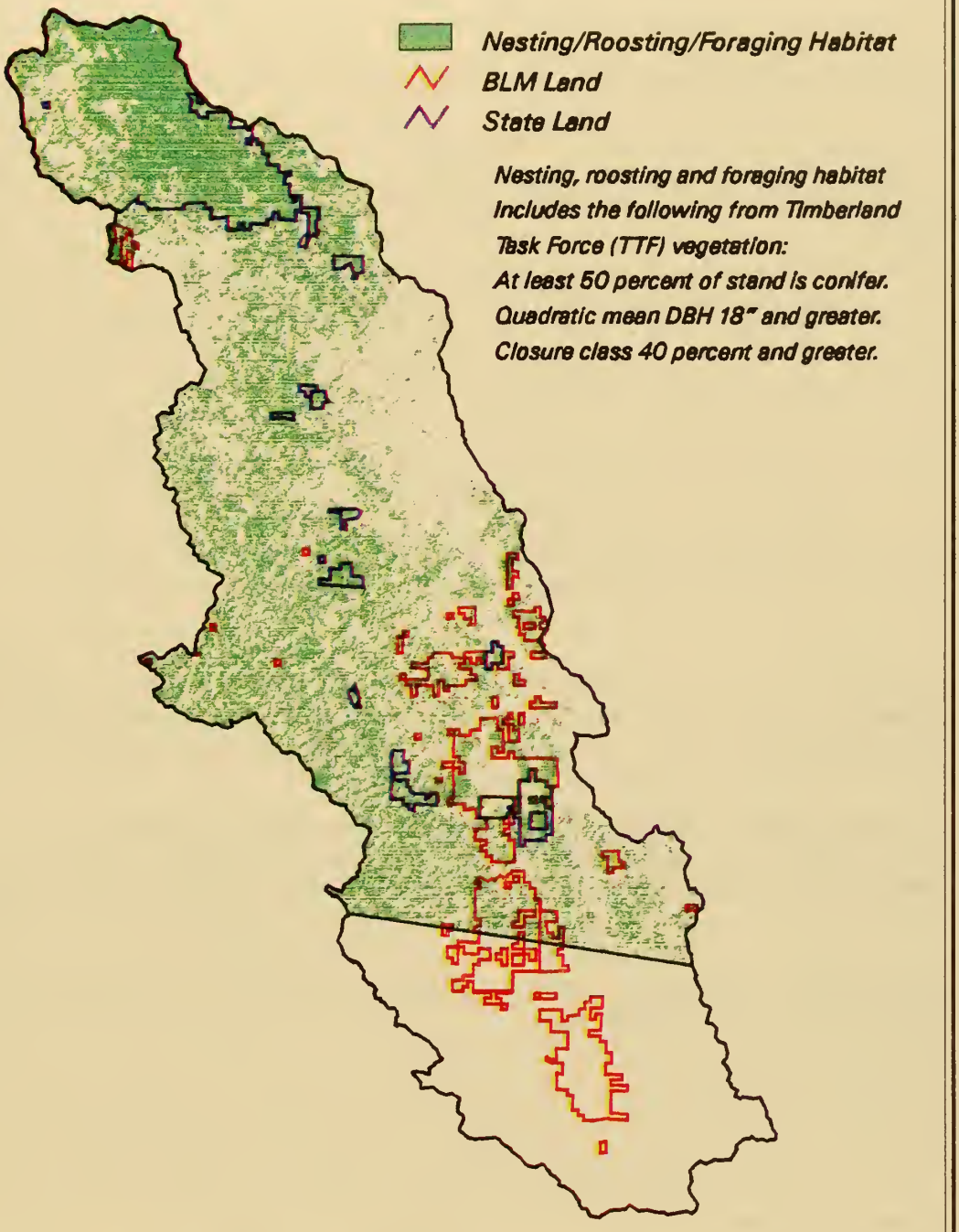

Nesting/Roosting/Foraging Habitat
BLM Land
State Land
Nesting, roosting and foraging habitat
Includes the following from Timberland
Task Force (TTF) vegetation:
At least 50 percent of stand is conifer.
Quadratic mean DBH 18" and greater.
Closure class 40 percent and greater.
RF 1:600000
Map Scale in Miles
1 0 1 2 3 4
UTM, Zone 10
Map Compiled by GIS Group
Watershed Analysis Center
November 21, 1996

Figure 4. Nesting, roosting and foraging habitat currently available for Northern Spotted Owl in the South Fork Eel Watershed, as modeled from TTF data. Note: Southern section of watershed omitted due to an uncorrectable error within the TTF data.

Ninety-seven percent of the land administered by the BLM in the South Fork Eel River watershed has been designated LSR, and the remainder is Matrix. Although portions of three LSRs occur within the watershed, only LSR RC-319 has substantial acreage in this watershed (Table 5). Nine percent of the watersheds portion of LSR RC-319 is considered spotted owl NR habitat.

Table 5. Late-Successional Reserves and northern spotted owl critical habitat in the South Fork Eel River watershed.

LSR #	Total Acreage	South Fork Access	Critical Habitat Unit #
RC-323	2,570	752	CA-51
RC-319	33,444	29,809	CA-52, 54, 55
RC-317	3,546	81	CA-56
TOTAL	39,560	30,642	

Dispersal habitat for northern spotted owls was queried for the northern portion of the watershed using any series which contained at least 50 percent conifers with trees at least 10.6-inch QMD and 40 percent canopy closure (TTF). According to TTF data, approximately 49 percent of the watershed contains habitat adequate for dispersal (Figure 5).

There are 35 known spotted owl activity centers within the watershed, with overlap from another 15 activity centers occurring outside the watershed boundary but dependent to some degree on habitat within the South Fork Eel River watershed. Of the 35 activity centers within the watershed boundary, 15 occur on BLM or state lands, and the remaining 20 occur on private lands (Table 6). There are no NSO activity centers in the Matrix and consequently no 100-acre LSRs. Six single owls occur within the watershed that do not meet the criteria for territorial single (one on state land, five on private land).

Table 6. South Fork Eel River northern spotted owl pairs and territorial singles. (California Department of Fish and Game database, 1994).

Allocation-Ownership	Inside Watershed Pairs/Territorial Singles	Outside Watershed Pairs/Territorial Singles	Total Pairs/Territorial Singles
BLM LSR RC-323	0/1	0/0	0/1
BLM LSR RC-317	0/0	0/0	0/0
BLM LSR RC-319	8/1	2/0	10/1
Subtotal	8/2	2/0	10/2
Calif. State Land (Parks)	2/1	1/1	3/2
Angelo Preserve	1/1	0/0	1/1
TOTAL	27/8	10/5	37/13

The USFWS considers an owl territory to be "taken" when the number of NRF acres drops below 500 acres within a 0.7-mile radius circle around the activity center, or 1,340 acres within a 1.3-mile radius circle. Preliminary take assessments were conducted to attempt to determine the feasibility of using TTF data for this analysis. The resolution of the TTF data is not refined enough to allow a high degree of confidence at the scale of these take assessments. The 1.3-mile radius of thirteen activity centers within or overlapping LSR 319, including two territories in the Angelo Coast Range Preserve (ACRP), were analyzed (Table 7). Although TTF is believed to over-estimate NRF habitat, Table 7 still shows that seven out of 13 territories were below take in the 1.3-mile circle (in bold in table). Only two of the 13 activity centers have more than 50 percent of their territories on BLM lands: MD267 is 91 percent on BLM land and MD368 is 52 percent. Thus, a similar take analysis using BLM vegetation data was conducted only for MD267 and revealed only three acres of suitable habitat. While we also believe the BLM data under-estimates suitable habitat, our confidence in the reliability of the results of a take analysis using TTF data precluded any further analysis.

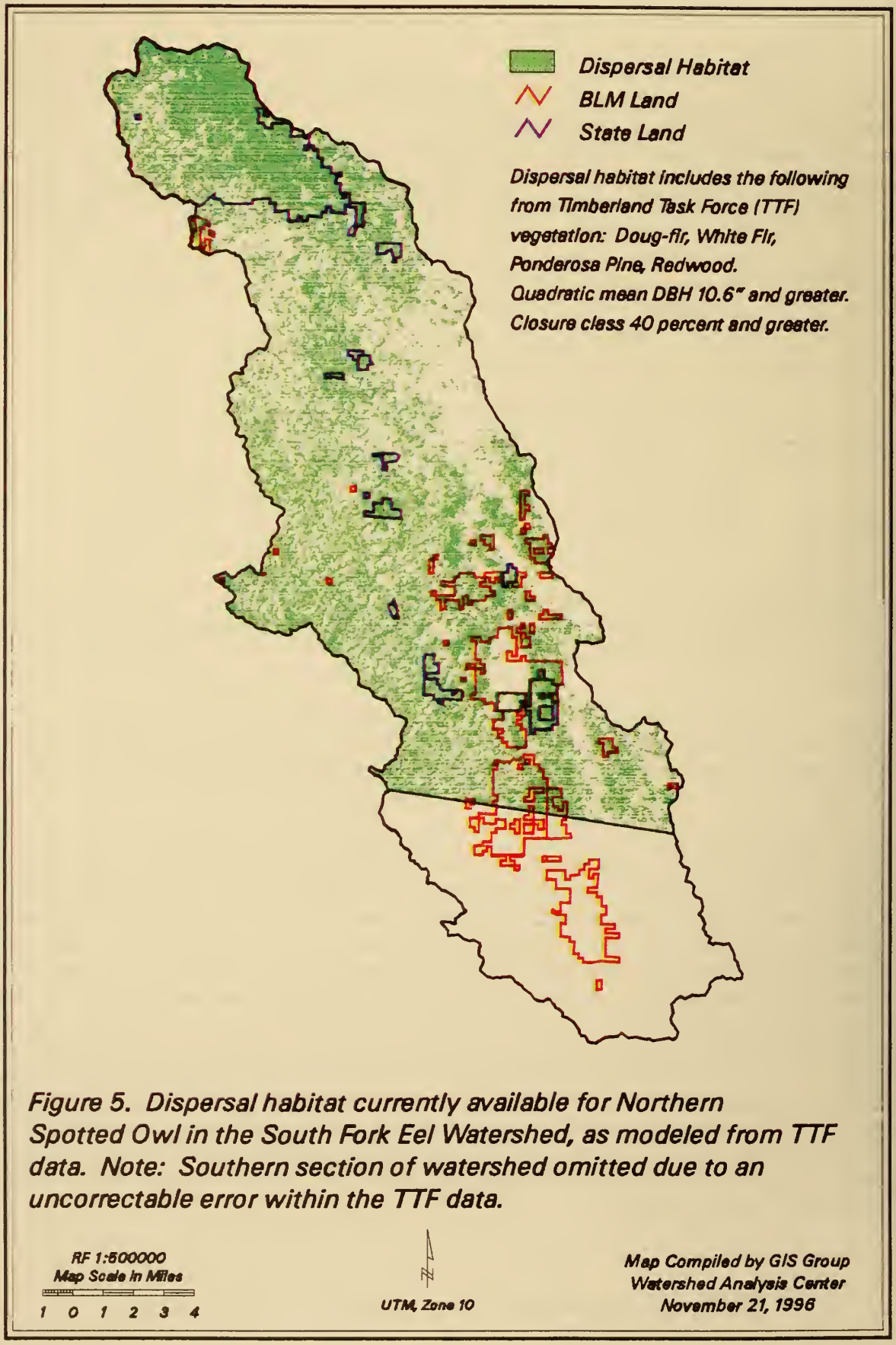

Dispersal Habitat
BLM Land
State Land
Dispersal habitat includes the following from Timberland Task Force (TTF) vegetation: Doug-fir, White Fir, Ponderosa Pine, Redwood.
Quadratic mean DBH 10.6" and greater.
Closure class 40 percent and greater.
RF 1:500000
Map Scale in Miles
1 0 1 2 3 4
UTM, Zone 10
Map Compiled by GIS Group
Watershed Analysis Center
November 21, 1996

Figure 5. Dispersal habitat currently available for Northern Spotted Owl in the South Fork Eel Watershed, as modeled from TTF data. Note: Southern section of watershed omitted due to an uncorrectable error within the TTF data.

Table 7. Preliminary analysis using TTF Data of the number of acres of northern spotted owl suitable habitat within a 1.3-mile radius circle of selected activity centers in the South Fork Eel River watershed. (Suitable habitat = greater than or equal to 50 percent conifer, greater than or equal to 18 QMD, greater than or equal to 40 percent canopy closure. P = pair, T - territorial single).

Territory #	Reproductive Status	Acres suitable w/in 1.3-mile	Owner
MD008	P	1,729	BLM
MD010	T	1,566	ACRP
MD011	T	1,642	BLM
MD012	P	1,403	ACRP
MD230	**P**	**925**	**PVT**
MD262	**P**	**598**	**BLM**
MD263	**P**	**1,255**	**BLM**
MD264	**P**	**587**	**BLM**
MD265	**P**	**785**	**BLM**
MD266	**P**	**512**	**BLM**
MD267	P	1,411	BLM
MD297	P	1,924	PVT
MD368	**P**	**1,019**	**BLM**

Critical habitat for the northern spotted owl was designated by USFWS in 1992. The South Fork Eel River watershed contains 28,979 acres (9 percent of the watershed) of NSO critical habitat. Of these acres, slightly over 98 percent (28,573 acres) are within LSRs, with the remaining 2 percent (442) in Matrix (Figure 6). The Critical Habitat Unit numbers and corresponding LSR numbers are shown in Table 5.

5. Marbled Murrelet

The South Fork Eel River watershed lies within Marbled murrelet Zone 1, within 22 miles of the Pacific coast (Figure 7). Marbled murrelets have been detected at sea throughout the length of the Eel River Basin and could occur in the watershed where suitable habitat still exists. Known locations include five occupied sites in Humboldt Redwoods State Park (LSRs M342, M343, and M344) and one detection in Hale Grove, southwest of Leggett.

Suitable habitat for marbled murrelets was queried for BLM land using the Douglas-fir, mixed conifer series which contained trees at least 24-inch d.b.h. and with at least 40 percent canopy

closure (BLM). Acres of suitable murrelet habitat totaled 2,350 acres, or 7.4 percent, of BLM's land in the watershed. Eighty-three percent (1,953 acres) occur in LSR, with the remaining 17 percent in Matrix.In 1994-95, BLM surveyed approximately 1,000 acres of suitable habitat in the Elkhorn Ridge/Cahto Peak area with no detections.

Proposed marbled murrelet Critical Habitat in the South Fork totals 81,790 acres (18.6 percent). Sixty-six percent (53,682 acres) of the proposed Critical Habitat occurs in State Parks, and 34 percent (28,108 acres) occurs in LSRs (Figure 6).

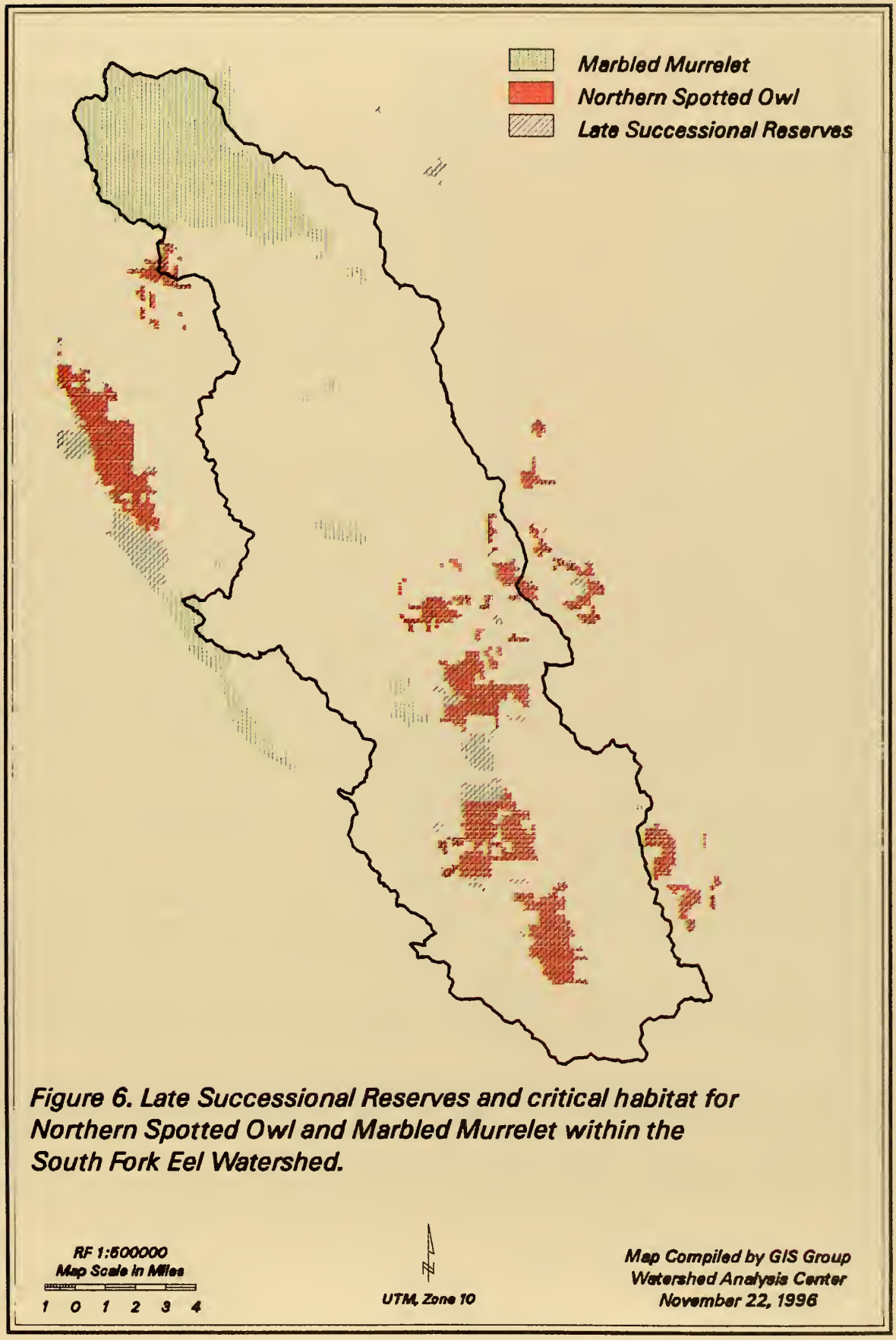


Figure 6. Late Successional Reserves and critical habitat for Northern Spotted Owl and Marbled Murrelet within the South Fork Eel Watershed.

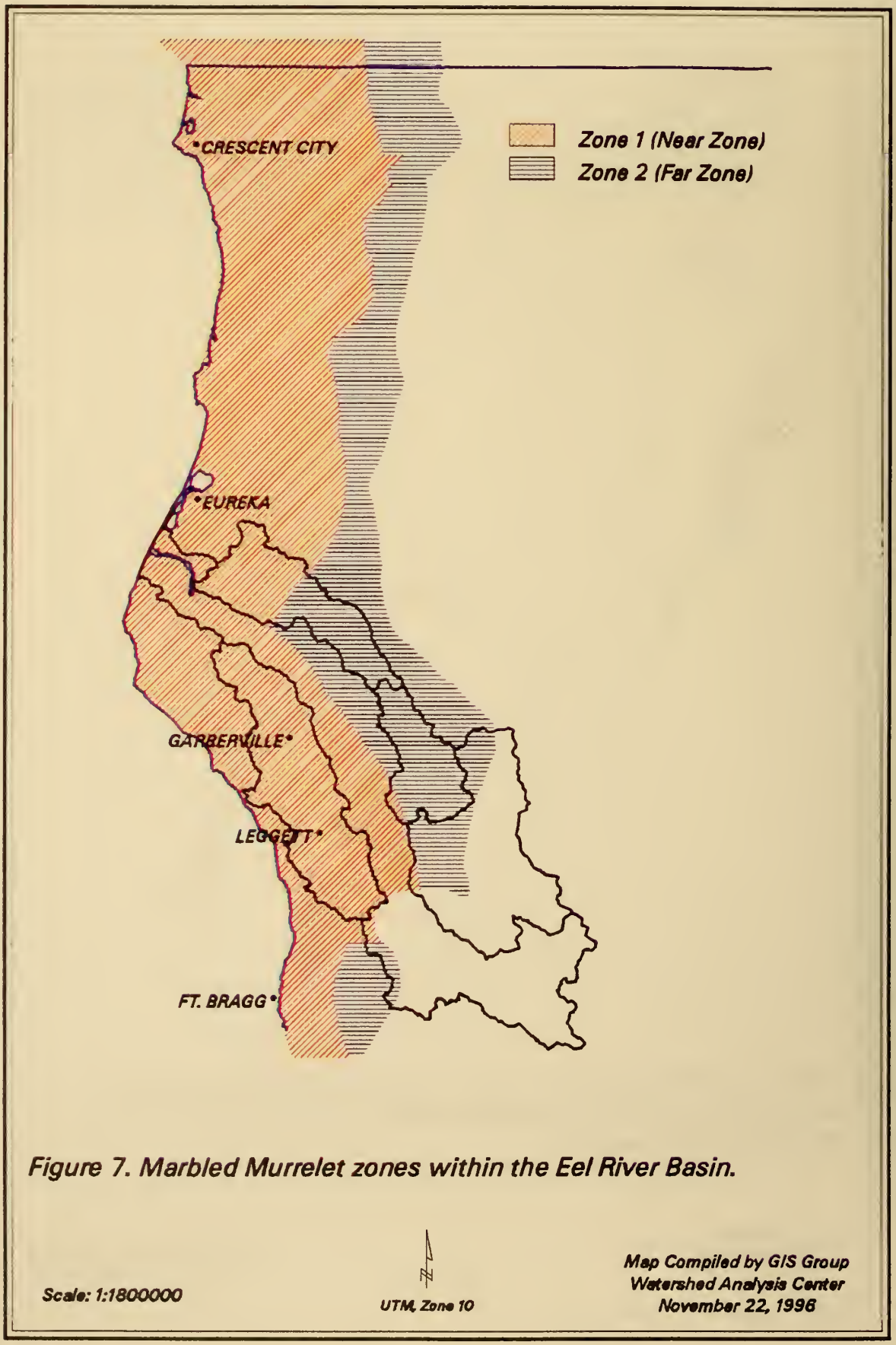


Figure 7. Marbled Murrelet zones within the Eel River Basin.

Special Status Wildlife Species

1. Northern Goshawk

Several goshawk territories are reported to occur in the vicinity of the Angelo Preserve/Cahto Peak and Elkhorn Ridge complex.

2. Bats

See Appendix B for life histories, habitat discussions, and threats. Eight species of bats listed in Appendix J-2 of the ROD or Species of Concern are known or suspected to occur in the South Fork Eel River watershed (Zeiner et al., 1990). No specific surveys for bats or their habitats have been conducted in the watershed. No caves or mine shafts are known to exist in the area, however, suitable roosting habitat may exist in rock outcrops, cliff crevasses and hollow old-growth trees, particularly redwoods. Old wooden bridges and abandoned buildings also may provide roosting habitat for some species.

3. Herpetofauna

See Appendix B for life histories, habitat discussions, threats, and answers to the amphibian wildlife questions from the 1994-96 Watershed Analysis Guidelines. An old-growth study was conducted by the Pacific Southwest Research Station from 1984-1986 to determine occurrence and abundance of forest herpetofauna relative to forest age and moisture (Welsh and Lind, 1991). The study included a total of 93 study sites in southwestern Oregon and northwestern California, in 42 stands of Douglas-fir/hardwood ranging from 30- to 560-years old. Twenty-seven of these sites (13 aquatic sites and 14 terrestrial sites) occurred in the southern part of the watershed near Branscomb. Species diversity was greater in older forests and amphibians were significantly more abundant in older stands than in younger stands. The South Fork Eel River watershed sites yielded six reptile species and twelve amphibian species. Three of the amphibians (southern torrent salamander, tailed frog, foothill yellow-legged frog) are Special Status species (Appendix B). The Del Norte salamander is not expected to occur in the watershed.

The Heath and Marjorie Angelo Coast Range Preserve has long been a site for research on old-growth forest in a watershed where natural processes have not been de-stabilized by human impacts. Twenty-six herpetofauna species (of which 11 are amphibians) are known to occur in the Preserve. Three species (yellow-legged frog, tailed frog, western pond turtle) are Special Status species (Appendix B). Researchers are studying the earliest invasion of the alien bullfrog into a relatively pristine reach of the watershed and the corresponding decline in native frogs, and the feeding ecology of the Pacific giant salamander larvae.

Incidental herpetofauna sightings also have been recorded during stream surveys conducted by BLM and the Institute of Sustainable Forestry. The Institute's sightings mainly have been in the creeks near Redway, Benbow, and State Parks.

Geologists and hydrologists have recognized the importance of Red Mountain geology in providing an underground reservoir of water that enables Cedar Creek to provide a significant proportion (17 percent) of the cold summer water flowing into the South Fork Eel River. The attributes of cold water and perennial flow make Cedar Creek potentially suitable habitat for tailed frog or southern torrent salamander. Several other areas appear to support locally high densities of springs (e.g., Salmon Creek, near Goat Rock, and south of Bear Buttes).

The extent of riparian vegetation along the South Fork Eel River and its tributaries is not known. Historical levels undoubtedly have decreased due to floods, grazing, timber harvest, road building, and development.

Survey and Manage Wildlife Species

There have been no surveys for Survey and Manage Wildlife Species in the South Fork Eel River watershed. Queries of the Survey and Manage database did not identify any known locations of vertebrate or invertebrate species.

1. Black-tailed Deer and Elk

Three different deer herds occur in the South Fork Eel Rive watershed. The Mattole Herd occurs on the west side of the watershed in Humboldt County, the Mad River Herd covers the east side of the watershed in Humboldt County, and the Noyes subunit of the Mendocinc Herd is found in the Mendocino County portion of the watershed, west of Highway 101. Tule elk were reintroduced near Laytonville.

2. Exotic Species

Barred owls have been detected northwest of Briceland in 1995, and are known to occur in neighboring watersheds.

Bull frogs were introduced into farm ponds in the early 1900s and have spread into adjacent riparian areas. Increases in bullfrog numbers are known to result in decreases in native frogs, including yellow-legged and red-legged. This decrease may be due to tadpole competition for algae and invertebrates, or direct predation (Kupferberg, 1995).

Several feral domestic animals have varying impacts on native wildlife species. The State Parks are concerned with the numbers of feral cats and dogs which will probably continue to increase with development. Small populations of feral pigs still exist in the southern part of Humboldt County and throughout Mendocino County. These current herds may be the result of recent releases by ranchers trying to supplement their incomes by leasing hunting privileges and guiding hunters for a fee. Wild boars were introduced into the Eel River Basin in 1961, north of Willits. Hybrid swine now are found primarily in Mendocino County, including a concentration in Elder Creek.

3. Survey and Manage Plant Species

Preliminary surveys have found eleven species of lichens and two species of plants in the BLM-managed portion of the watershed.

Fire Hazard Assessment

Changes in the fire regime due to human-caused impacts and suppression efforts have had and will continue to have a great affect on terrestrial species.

Specific hazard assessment for this area is difficult because of the lack of reliable vegetation data that could be converted to fuel models for fire behavior modeling. Available Timberland Task Force data had data discrepancies on the lower end of the watershed which made it difficult to consistently interpret the vegetation. It can be assumed that aggressive fire suppression over the last 50 through 80 years has allowed for an increase in stand density and general flammability of the wildlands. Wildfires that exceed initial attack could become much more intense and destructive, especially if there is a significant draw-down of firefighting forces due to higher priority wildfires elsewhere (i.e., in areas with a greater number of structures).

On BLM land a high hazard has been determined for the area between Brush Mountain and Elkhorn Ridge. It has been chosen as a high priority for the State's Vegetation Management Program, which involves prescribed burning to reduce fire hazard on state protected lands.

Two other areas within the South Fork Eel River watershed were specifically addressed in the BLM Fire Operating Plan (1/12/96): Red Mountain Area of Critical Environmental Concern (ACEC) and Angelo Coast Range Reserve and Elder Creek ACEC. The general management objective for Red Mountain ACEC is to prevent fire suppression actions that would impair the suitability of the area for designation as wilderness and protect existing rare plant habitat, old-growth Douglas-fir and foraging habitat for raptors. The Angelo Coast Range Reserve and Elder Creek is a natural area managed jointly by the University of California, Berkeley, and the Bureau of Land Management. This area has been recognized through federal designation as a Research Natural Area and Area of Critical Environmental Concern. The goal of the Preserve is to protect and preserve the natural diversity of the area.

Within Humboldt Redwoods State Park natural fire frequencies and processes have been disrupted by historic management practices. Higher frequencies and intensities of fire during the initial settlement period coupled with efficient fire suppression and prevention practices of the last 50 years have resulted in the unnatural stand-age structure of the forest and woodland species, and the invasion of the prairies by both shrub and tree species.

Due to the historic disturbances of timber harvest, grazing, wildfire, floods, and recent decades of fire suppression, the fuels in Humboldt Redwoods State Park have been dramatically altered, increasing fire hazard in many areas of the park. The upper Bull Creek watershed is no longer dominated by late seral Douglas-fir forest, it is now covered primarily by flammable early seral conifers and evergreen broadleafed species such as tanoak and madrone. The old-growth redwood forests found elsewhere in the park have probably not changed materially in the last 100 years or so. However, live fuels and large fuels on the forest floor have changed. Evergreen huckleberry and tanoak have increased in volume and canopy cover beneath old-growth redwood canopies in recent decades. With fire suppression, recycling surface fires have not consumed windthrown trees and other large coarse woody debris.

Suppression Effectiveness

Of equal importance to a hazard assessment is the determination of suppression effectiveness once a fire does start. Suppressing fires while they are still small requires a mix of initial attack resources that is more mobile than what has been traditionally required. The current organization for CDF emphasizes ground attack as the primary initial attack resource, with support from air attack for extended attack. CDF would supply crews from Eel River (5 crews), High Rock, Alderpoint (one engine), Garberville (two engines, one dozer), Thorn, and the Mendocino Ranger Unit. Local air support would include Kneeland and/or Howard Forest helicopters and air tankers out of Rohnerville and Ukiah. Numerous volunteer fire departments would also respond. Due to the mainly rural population of this area, fires would have a lower priority when compared to more populated wildland intermixes found throughout the state. This could be a significant factor when forces are drawn down past effective levels, possibly resulting in significantly larger and more destructive wildfires.

As stated within the resource management policies and guidelines for Humboldt Redwoods State Park, "The use of fire in the state park system shall not in any way diminish the importance of, or continuing need for, the prevention and suppression of destructive wildfires." Fuelbreaks and

firelines are to be kept to a minimum to prevent erosion and unwanted human traffic in sensitive areas.

Synthesis and interpretation

TES Species recovery

In what ways can the South Fork Eel River watershed contribute to the recovery of threatened, endangered and special status species?

Key Questions:

1. Does adequate habitat exist to maintain viable populations of threatened, endangered and special status species in the South Fork Eel River?

This watershed is predominantly covered by coniferous forests, with Douglas-fir or redwood as the dominant conifer types. Hardwoods are an important component within the Douglas-fir forests, and they occur as a distinct woodland habitat type in the western and southern portions of the watershed. The watershed becomes naturally fragmented along the west side of the mainstem, and in the southern portion of the drainage, where conifer forest and oak woodlands are interspersed with shrublands and grasslands. Most of the watershed has been intensively managed [timberlands harvested or converted to rangelands], therefore most of the forested area is in the early-successional stages on private lands. Most of the public land is protected as State Parks or federally designated LSRs, administered by the BLM. Most of the coniferous forest on BLM is in mature or older age classes. Only 6 percent of the Douglas-fir on BLM-administered lands is in the early successional stages [size classes 1-3].

Fire suppression has facilitated the increase of tanoak in the understory, which has reached densities that may preclude foraging by some species, and increased the vulnerability these mature and late-successional areas to stand-replacing fires. Suppression has also allowed the encroachment of Douglas-fir and black oak into white oak woodlands, with localized increases in early- and mid-mature conifer habitat, providing atypical habitat to some species that need mature conifer forests. California Department of Forestry records indicate that most (85 percent) recent fires within the South Fork Eel River watershed are caused by humans.With the cumulative increases in down woody debris and the ladder fuels that result from maturing understory vegetation, the risks of large catastrophic fires is high.

1. Peregrine Falcon

Habitat does not appear to be limiting peregrine falcon recovery, however disturbances at active territories and chemicals in prey species continue result in nest failures. The normal weathering of cliff ledges may be a concern at some sites, especially those that may regularly fail. A viability assessment of the California peregrine population, found the North Interior sub-population had the potential to be a "stable source population" for both southern California and southern Oregon (Wooton and Bell, 1992). Viability was dependent on the adequacy of adult survivorship; most of the discovered nests were newly colonized sites. Annual monitoring of all known sites and most potentially suitable cliffs is essential to their eventual recovery.

2. Bald Eagle

An evaluation by Detrick and Garcelon (1986) determined that the Eel River Basin had a limited potential to support bald eagles and the recovery plan (1986) assigned a goal of six breeding pair for the entire basin. The Eel River does not appear to support many osprey either. All currently known or suspected pairs occur along the mainstem [including Lake Pillsbury], however

wintering bald eagles have been reported frequently in the Sproul Creek watershed. While nesting habitat along the South Fork certainly appears adequate, it may not be suitable in the vicinity of those unique river conditions that are optimum for foraging, or free from disturbance. Bald eagles nesting late in the winter are also vulnerable to displacement as human activity increases on the river during the spring. Bald eagles are most likely to nest downstream from the BLM parcels, closer to the confluence with the mainstem of the Eel River. The increasing abundance of *P. Grandis* and suckers will increase summer foraging opportunities.

3. Northern Spotted Owl

Little mature or late-successional coniferous forest remain within the South Fork Eel River watershed, and the largest contiguous parcels occur in state parks, the Angelo Coast Range Preserve, or on BLM lands. The TTF data indicates that the late-successional forest habitat [Size class 5 and 6, 24" QMD d.b.h., and 60 percent canopy closure] remaining on private lands is primarily in the small groves left as streamside buffers. While the larger contiguous forested areas will certainly support several owl pairs, it does not appear likely that the large blocks of BLM-administered land will be capable of providing sufficient mature and late-successional habitat to support more than 5 to 10 spotted owl pairs, and if so with a high risk of stand-replacing fire. Only 8,500 acres of Douglas-fir timber type occur within the BLM lands in the South Fork Eel, and just over 3,000 acres is considered suitable Nesting and Roosting (NR) habitat. Another 5,000 acres of mature and late-successional habitat exists but it is poor or sparsely stocked.

Years of fire suppression have allowed understory hardwoods and shrubs to reach high densities, and to provide ladder fuels that make stand-replacing fires inevitable. Selective timber harvest and salvage has left some managed forest stands understocked, with sparse conifer overstory canopies and dense hardwood understories. Isolated parcels of state and federal lands are often more similar to the 100-acre "residual owl areas" that provide a little suitable Nesting and Roosting habitat, as islands, surrounded by young, intensively managed forests. It is uncertain how the young, intensively managed forests will contribute to the long term needs of the spotted owl or other special status species that require mature or older forests.

4. Marbled Murrelet

All of the South Fork Eel River watershed occurs in the Near Zone, and while several areas of suitable marbled murrelet habitat have been surveyed [areas and transects] within the watershed, only a portion of Humboldt Redwoods State Park appears to occupied. Biologists with California Fish and Game, believe it to be unlikely to find murrelets upstream from Miranda, however late-successional habitat that occurs along the western edge of the South Fork drainage, from Gilham Butte south to Branscomb, is potentially suitable and close to the Pacific coast.

5. Other Special Status Species

There is little information for species of concern or ROD species that are likely to occur on federal lands in the South Fork Eel River, and basic inventories are needed (see Appendix B). While we assume these species will be provided for and are protected within the LSRs, a better understanding of their habitat requirements, and their response to different management activities is essential to their long-term protection.

Riparian forest habitats are generally buffered but have been damaged by floods. The impacts of the floods were influenced by previous timber harvest and associated roading, and the deposition of sediment has certainly altered the aquatic system. Rural development, road building and

domestic water uses [impoundments and diversions] has also impacted the extent of he riparian habitat. Added to a declining riparian component the invasion of exotic wildlife species, and extirpation of some special status species becomes of the utmost concern.

6. Herpetofauna

The study (Kupferburg, 1995) of the invasion of the bull frog, indicates that aquatic surveys are essential to determine the extent of their distribution and impact. It is realized that it may already be too late for some native species that may have been locally extirpated already. We need to find restoration methods that will maintain native species and to improve riparian habitat quality in ways that will help natives survive.

7. TES Plants

For rare and endangered plant species there is adequate habitat for some species and limits on habitat for others. McDonald's rockcress appears to have adequate habitat in the area of Red Mountain and is well protected on public land through provisions put forth by the ACEC/RNA Activity Plan and the Endangered Species Act. There may be some concern for the habitat of McDonald's rockcress on private land as there is a proposed timber sale in the area of Red Mountain. Timber harvests in redwood forests may also be adversely affecting the habitat of the ROD species, California fettid adderstongue (*Scoliopus bigloveii*). Timber harvests in and around white oak woodlands may also adversely affect potential habitat for beaked tracyina and Tracy's sanicle.

2. What are the current limiting factors for species of concern?

Habitat quantity and quality is limiting for those species dependent upon late-successional and old-growth habitat conditions, and the size and arrangement [fragmentation] of these areas has significant influence on the effectiveness these remaining suitable locations. Suitable riparian habitat and aquatic habitat conditions are also likely to be limiting in most tributaries and along the South Fork Eel River, as sedimentation fills pools and alters the riparian communities. Competition (including exotic species) for limited resources , destruction of suitable habitat and predation by exotic wildlife species are likely to have a more significant adverse affect on declining populations. In addition, the cumulative affects that result from multiple factors acting on these rare or uncommon special status species further aggravate the declines.

Some forest stands are being replaced by hardwoods, and the hardwood understories of some stands have become so dense that the mast crop has likely declined and the area may be difficult for some species to forage within. In managed or regenerated stands there appears to be a deficiency in snags and possibly coarse woody debris. These deficiencies will persist as the stands mature, and those special habitat components that require time to create, such as soft snags or the later decay classes of the down woody debris, will likely result in smaller numbers of species dependent on these stand attributes.

Bureau of Land Management lands are generally remote, with access limited to a few roads; thus, disturbance is expected to be infrequent, and probably of relatively short duration. Access during high fire hazard periods are major concern for the maintenance of Late-Successional Reserves.

3. What is the significance of the South Fork Eel River in sustaining TES species and their habitat, as well as contributing to the recovery of previously more abundant species? What is the role of federal lands in this recovery?

The South Fork Eel River watershed is important for ensuring that the recovery effort is well distributed within capable habitat throughout the range of these species or provide some suitable habitat that may facilitate dispersal between reserves that occur in neighboring watersheds. The presence of state parks and federal Late-Successional Reserves (LSRs), that are generally managed to ensure mature and older forest conditions, provide refugia within the South Fork and dispersal habitat to similar late-successional forest reserves in adjacent watersheds. The LSRs range from small parcels [80+ acres] to large, almost contiguous blocks such as Red Mountain, which is composed of three parts [Red Mountain, Elkhorn Creek and Cahto Peak]. The southernmost parcels along the South Fork Eel River, Elkhorn and Cahto Peak are connected by the Angelo Coast Range Preserve which is managed by the University of California, Berkeley. These LSRs simply maximize what little public land occurs in the watershed, and it will probably take decades of monitoring to determine whether they are making a significant contribution.

1. Northern Spotted Owl

Though the South Fork Eel River watershed LSRs have importance in the location as the southernmost opportunity to manage an interacting population center in the range of the northern spotted owl, natural and human-caused fragmentation, along with limited public ownership, limit opportunities for securing these habitats in the long term. It appears that Gilham Butte has the potential to support an owl pair or to provide some habitat for two NSO pairs, and it could provide habitat for the murrelet. The Red Mountain parcel provides essential habitat for threatened and endangered and rare plant species, the peregrine falcon, and one successful NSO pair. Though additional single owls, and occasional owl pairs, occupy fragmented habitats throughout the parcel, there is limited potential to provide sufficient late-successional habitat to secure these sites as productive territories. This parcel currently provides some habitat for several NSO pairs. The Elkhorn parcel has the most potential to support additional owl pairs in conjunction with the Angelo Preserve, and the northernmost portion of the Cahto Peak parcel. There is generally insufficient suitable habitat in most BLM LSRs to support additional owl pairs, a situation that is not likely to improve over time, unless opportunities to exchange for contiguous parcels of suitable forest habitat become available. The effectiveness of these LSRs will also depend to some extent on the management of adjacent private lands as well as the ability of the listed species to colonize new habitat as it becomes functionally suitable.

2. Marbled Murrelet

While the South Fork Eel is entirely within the near zone for the marbled murrelet, it is not yet clear whether the BLM parcels will contribute much to their recovery. Surveys to protocol, in some of the best habitat in the Elkhorn area failed to detect murrelet. The Gilham Butte parcel probably has the greatest potential for future occupation by murrelet, and possibly the eastern portion of the Elkhorn parcel will eventually contribute some suitable murrelet habitat.

3. Other Special Status Species

The South Fork Eel River watershed has provided habitat for the northern goshawk, Pacific fisher, red tree vole, northern red-legged frog, western pond turtle, and foothill yellow-legged frog. However suitable and potentially suitable land that occur on state and federal lands is limited and habitat quantity and quality is declining in several areas. The watershed provides an important transition between moist coastal/ fog belt habitats and dry inland habitats.

4. TES Plants

The late-successional reserves and state parks are also important to several plant species. The late-successional reserves may provide refugia for the seven non-vascular ROD species that have been identified on federal lands. The parks may provide the remaining habitat for the California fettid adderstongue and other species associated with redwood forests. The Red Mountain area is also important to the southern population of McDonald's rockcress. This is an isolated population and may be genetically distinct from the northern population.

4. What management actions, if any are needed in the South Fork Eel River watershed to facilitate recovery of, or mimic natural processes essential for, TES species?

Before any actions may proceed on federal lands designated as Late-Successional Reserve, an LSR assessment must be completed, consistent with direction in the Northwest Forest Plan and ROD, and the ROD for the amendment to the Arcata Resource Area RMP. The Standards and Guidelines (ROD, [pg. B-1], 1994) for LSRs were designed to maintain late-successional forest ecosystems, protect them from loss due to large-scale fire, insect and disease epidemics, and major human impacts. The ROD intended the LSRs be managed to maintain "Structure and Composition," Ecological Processes" and "Disturbance Risks".

The most important prerequisite to this assessment would be a reclassification of the vegetation to series, sub-series, including successional stages; with supplemental evaluations of fuel loading, and baseline snag and coarse woody debris levels.

Complete road inventory and develop a Travel Access Management Plan as part of LSR assessment. Close non-essential roads to manage "Disturbance Risk."

Accelerate land acquisitions that continues to block-up the larger parcels and identify essential habitat parcels with willing owners that would target essential and occupied T&E species habitat.

The existing federal ownership provides suitable habitat, however its distribution is less than ideal from the perspective of species recovery. Late-successional forest habitat in the Red Mountain LSR area appears to ring the relatively unsuitable serpentine Jeffrey pine /chaparral and cypress vegetation types on top, and the forested habitat is also fragmented to some extent by grasslands, shrub/chaparral and hardwood stands. The Cahto Peak parcel appears to provide little mature or old-growth coniferous forest habitat, and much of the mature tanoak/ Douglas-fir series on federal land is either poorly stocked, or hardwoods have become increasingly dense in the understory. The most suitable late-successional habitat occurs in the northern end and along the tributaries.

There are few early-mature coniferous stands available for thinning; however, there are some previously managed stands that may be available for thinning soon. The are also opportunities to reduce the hardwood understory along roads, and manage them as natural fuel breaks. There is a relatively large component of poor or sparsely stocked Douglas-fir-tanoak forest, that is not available for management and that appears to be declining in suitability. These stands are not expected to improve, and the conifers will continue to be replaced by hardwoods, until a stand-replacing fire is allowed to occur. The suitability of these timber types must be re-evaluated for management if we are to expect these LSRs to achieve their desired potential, or in order to exchange these types to acquire other suitable areas.

Fire suppression has allowed considerable ingrowth of tanoak and brush in the understory, and currently green fuels appear high. As competition-induced mortality begins to play a role, coarse

woody debris will become high as well. With human-caused fires accounting for approximately 85 percent of the fires on record, the risk of having a significant stand-replacing fire within these LSRs is high. Fuels management along primary access roads is crucial, and managing public access during the fire season (particularly restricting access to areas that remain untreated and have hazardous fuel loadings)is likely to be critical to protecting the late-successional habitat that would characterize these LSRs. Federal land managers need to ensure that fire remains an essential "ecosystem process," and allow it to occur where the risks are acceptable, while preventing large-scale loss of late-successional forest.

TES Plants

Fire can be both beneficial and destructive to rare plants. Fire can help release nutrients needed by rare plants for germination and growth, stimulate the germination of the seed bank, maintain rare plant habitat by "setting back the clock" on succession in meadows and/or reduce interspecific competition in serpentine habitats. Fire can also create openings for the invasion of exotic plant species. Although there may be benefits to the use of fire to enhance or restore rare plant habitat, it is best to use this method on test plots and monitor the results over several years.

5. What factors contribute to the introduction and dispersal of exotic species that are detrimental to TES species within the watershed? What control measures or changes in land management are needed to reduce or eliminate the impact and dispersal of exotics within the watershed?

Unfortunately mankind, and the short-term needs or economic returns desirable to individuals have been responsible for most exotic introductions with little concern or knowledge for the long-term consequences of such a release on the environment. The bull frog, introduced to feed settlers, or feral pigs, originally brought into Eel River Basin farms for food, have persisted and expanded beyond most peoples expectations. Environmental factors have influenced the expansion of both, but not sufficiently enough to eliminate either. Bull frogs have reportedly expanded their range upstream to the Angelo Preserve, and are replacing or reducing native frog populations. The feral pigs have reportedly hybridized with the wild boar introduced by the State for hunting, and are reported to be expanding their range as well. The opossum has supposedly expanded its range from the south. The barred owl is the most recent (1995) exotic discovered in the South Fork Eel River watershed, and it is likely to displace spotted owls in intensively managed forested habitats in the timberlands throughout the Eel River Basin.

Federal agencies need to coordinate with the State resource agencies to develop a strategy that would restrict future exotic introductions and establish priorities to reduce, eliminate, or limit the continued invasion of exotics that are adversely affecting federally -listed species or that have a potential to further jeopardize these species and their recovery. While most of these species occur on private lands, their invasion into federal lands designated as Reserves, certainly limits the capability of the Reserves to support viable sub-populations of most forest wildlife species, even when suitable habitat is adequate.

6. Which of the exotics are control priorities?

While all exotic species pose a threat to native ecosystems, some have been around long enough to become well-established and available control methods may be as detrimental as the species itself. It appears the bull frog has the potential to be the most damaging (along with the *P. grandis*); however, the recent increase in barred owl reports in northwest California is equally

alarming although probably not a priority for control. As human development brings more people into the South Fork Eel River watershed, feral dogs and cats are likely to increase.

The main exotic plant species in the area are the annual grasses that dominate most grasslands and glades throughout California. These species are believed to have been introduced by European settlers in the 1500s and they have proliferated due to intensive livestock grazing on these lands. Other exotic plant species such as yellow star thistle (*Centaurea solsitialis*) have been identified in this watershed but do not appear to be a problem. Most exotics are opportunistic invaders in openings created by disturbance such as fire, logging, and road building.

7. How fragmented is the South Fork Eel River watersheds' Late-Successional Reserves (LSRs) and what actions are needed to minimize fragmentation?

The BLM ownership within the watershed is somewhat fragmented, since it occurs in scatter parcels, and the large blocks are naturally fragmented by coniferous forest, oak woodlands, shrubs and grasslands. As mentioned previously, other unsuitable vegetation series occur on most parcels, such as Red Mountain, where the serpentine Pine/shrub forests on top are ringed by suitable Douglas-fir/tanoak forests to the north, east and south. In some cases, the federal land contribution to individual territories is inadequate to ensure long-term success. In other blocks [Elkhorn Creek and Gilham Butte] the internal fragmentation appears insignificant. Natural fragmentation occurs within the Cahto Peak area.

Continue current land acquisition program to block up ownership with desirable habitat, and reassess the adequacy of current LSRs to meet the long-term recovery needs of late-successional species.

8. What is the relationship of LSR land in the South Fork Eel River watershed with other nearby LSRs?

The small Gilham Buttes parcel [LSR RC-323] provides some connectivity between the Humboldt Redwoods State Park to the north and the King Range to the west along the Pacific coast. The Red Mountain/Cahto Peak complex [LSR RC-319] provide a refugia and some stepping stone connectivity between the Six Rivers National Forest LSR [RC-307] to the northeast, the King Range to the west, and other scattered BLM LSRs to the south and east [RC-317, 318, 320 etc.]. Some of the smaller, scattered BLM parcels are similar to the 100-acre LSRs that have little potential to maintain a spotted owl pair. While these scattered parcels may facilitate dispersal and provide secure suitable habitat for the short-term, it may be more important to acquire suitable habitat adjacent to the larger habitat blocks (and within an owls' nest core area [0.7-mile circle]) if we expect these LSRs to support some minimum number of breeding spotted owl pairs as a desired long term recovery goal.

9. What is the fire hazard in the South Fork Eel River watershed and what treatments could help to reduce the hazard? Which are the priority areas to treat?

Fire Hazard

The changes in vegetation composition and density noted within Humboldt Redwoods State Park are probably reflected elsewhere in the watershed to varying degrees. Thus, high to extreme fire behavior could occur in large areas throughout the watershed, especially under late summer conditions (when recreation and traffic is typically at its highest levels). Wildfires with very high to extreme fire behavior could drastically affect wildlife habitat, soils, vegetation, water quality, and channel morphology. A large, catastrophic fire could set back thousands of acres of

current late-successional habitats to earlier seral stages, thus reducing habitat for many late-successional TES species. For federal lands, both the Red Mountain area and the Elkhorn area are treatment priorities but treatment will vary greatly between these two areas based on the land ownership patterns and road access.

ISSUE 4

Access

Issue Statement: What strategy(ies) should the Bureau of Land Management follow in managing access to federal lands in the South Fork Eel River watershed?

Reference Conditions

Reference conditions are not applicable to this issue.

Current conditions

About 81 percent of the South Fork Eel River watershed is held in private ownership. The large blocks of public land managed by BLM are located in the Red Mountain Planning Area, Cahto Peak, and Elkhorn Ridge (Figure 2). This area is bisected by US Highway 101. From the perspective of road access, the area can be stratified into the portion north of Highway 101 and the portion south of Highway 101. Highway 101 is a major thoroughfare in the region with an average of 6,400 vehicles passing through this area each day.

To the north of the highway, BLM public lands are generally accessible to the public via Red Mountain Road and its' associated road system which is owned and maintained by BLM. This road system connects with Highway 271 just a few hundred yards from an onramp-offramp to US Highway 101 and is thus readily accessible throughout the year. This road system is located mainly on, or near, ridgetops and includes parts of the Red Mountain Creek watershed, the McCoy Creek watershed, and the East Branch South Fork Eel River watershed. The road system provides access to numerous private parcels in and around this block of the Red Mountain Planning Area. Although no formal recreation facilities exist, the system provides easy access for dispersed recreation such as hunting and camping.

No formal studies of road use have been conducted. Hunting is the main recreational use of the road system and thus use is concentrated during deer hunting season. A rough estimate of 1,000 visitor days was calculated for the Red Mountain Road system (BLM Arcata Resource Area 1989; Bruce Cann, pers. comm.). Red Mountain Road system provides the sole access to numerous 40- and 80-acre parcels, some of which contain homesites and permanent, year-round residents. In addition, the Red Mountain Road system provides the sole access to surrounding private timberland and allowing the system to be used for timber hauling on an intermittent basis, mainly during the summer months. Permanent residents and timber hauling outfits contribute far more to road use than recreation use from the general public.

The block of public land west of Highway 101 is currently much less accessible to the public via roads. This block of land contains a Key Watershed (South Fork Eel River from Elder Creek to Low Gap Creek) and a section of Wild and Scenic River. Except for access provided to Camp St. Michael (a private camp operated by the Catholic Church), vehicle access to this block of land is via Branscomb Road and is not signed as public access. The BLM-owned road system is the sole access to private residences and private timber land, and it is used for ingress and egress as well as timber hauling. This area receives insignificant use from recreationists.

The greatest amount of public use for the block of land south of Highway 101 comes from summer use of Camp St. Michael. Camp St. Michael, under a special recreation use permit from BLM, installs a low water stream crossing to access their property each year from June through August. Road access (from a location known as The Hermitage) across BLM land is approximately

0.5-miles. Approximately 300 children attend the camp each year, generating intense use of this short section of road. Camp St. Michael attendees use the system of abandoned logging roads located on public lands acquired by BLM in the 1980s as a trail system to access the Wild and Scenic portion of the South Fork Eel River. Aside from Camp St. Michael, no public access is available from the eastern edge of that block of public land.

The Bureau of Land Management plans to acquire public access to the western block of land at the Camp St. Michael's road via a permanent exclusive easement. In association with this, a public access trail loop system is proposed within the Wild and Scenic portion of the South Fork Eel River (BLM, 1990). This access point is easily reached and is within a five minute drive from Highway 101 via Highway 271. Given the heavy use of Highway 101, development of public access to this area should greatly increase the number of visitor days into this block of land. The type of visitor use will be primarily backpacking and primitive recreation which should create little environmental impact. Although, given the degree of fire risk in the area and given that fire risk correlates positively with public access, the potential increase in visitor use is likely to cause an increase in fire risk.

Synthesis and interpretation

1. What are the principal concerns and opportunities in this watershed for managing public access?

The major opportunity for increasing public access is to acquire public access at The Hermitage which would allow access to the Wild and Scenic portion of the South Fork Eel River. BLM has planned to develop this access in conjunction with a parking lot, a visitor information kiosk, hiking and equestrian trail systems, and associated primitive campgrounds (BLM, 1990). Development of this access and trail/camp system has the potential to substantially increase the number of recreation user days in this block of public land, considering the easy access year around from Highway 101. For more detailed information on BLM plans for this access acquisition and recreation facilities consult "River Management Plan and Environmental Impact Statement South Fork Eel Wild and Scenic River" (BLM, 1990).

The principal concern with public access is the potential for increasing fire risk and fire hazard. Other environmental impacts are likely to be minimal.

2. What is the trend of fire risk within the South Fork Eel River watershed and what can be done to decrease the number of human-caused fires, especially in terms of access?

The typically dry summer environment and existing vegetation types indicate that wildfires have been a major component of the South Fork Eel River watershed ecosystem. Burning by Native Americans and European settlers was also frequently practiced throughout this area for various forest and grassland products. The Fire Management Plan for Humboldt Redwoods State Park mentions that their pre-European fires probably were caused mostly by Native Americans. The Sinkyone Tribe were the primary inhabitants of the region with established villages in and near the Bull Creek watershed. Regular burning by the Sinkyones was reported as a means to drive out insects and rodents for food and to keep the forest understory open for travel.

Fire Occurrence

Available digital CDF fire report form data for the South Fork Eel River watershed covers the period from 1981 to 1993. This period is relatively short but gives an indication of the trend of mainly human-caused fires for this area. A total of approximately 731 fires occurred between

1981 and 1993 within the watershed, with 96 percent being human-caused and four percent attributed to lightning.

Table 7. Breakdown of numbers of acres burned by cause and years.

Year	Human-caused # acres	Lightning # acres	Total # acres
1981	60 (53)	0 (0)	60 (53)
1982	30 (30)	0 (0)	30 (30)
1983	54 (10)	0 (0)	54 (10)
1984	76 (633)	1 (<1)	77 (633)
1985	83 (51)	0 (0)	83 (51)
1986	53 (22)	0 (0)	53 (22)
1987	87 (86)	2 (<1)	89 (86)
1988	67 (23)	0 (0)	67 (23)
1989	28 (55)	2 (1)	30 (56)
1990	63 (94)	3 (151)	66 (245)
1991	35 (34)	6 (9)	41 (43)
1992	38 (32)	4 (6)	42 (38)
1993	30 (11)	9 (1)	39 (12)
TOTAL	704 (1134)	27 (168)	731 (1302)
% of Total	96% (87%)	4% (13%)	

The vast majority of the recorded fires were small in size, with only three recorded fires greater than 100 acres (the largest being 287 acres). Several factors have contributed to the small size of the vast majority of fires within the watershed:

- extensive initial attack coverage from several crew bases within relatively close proximity;
- good access to location of frequent fire starts;
- good detection coverage from local residents and lookouts; and,
- local rancher and volunteer fire department contributions to the fire fighting efforts.

The majority of the human causes were attributed to arson, miscellaneous (including burning building, industry, lumbering, resident), and debris burning. The greatest number of fires were within the Benbow sub-watershed, with Garberville as the highest sub-area. Lightning was a very small component of the fire frequencies within this watershed during the period of 1981-93, and when it does occur it usually occurs with moisture.

The Prescribed Fire Management Plan for Humboldt Redwoods State Park mapped several fires larger than 300 acres during the period 1930-79. Seventeen fires greater than 300 acres occurred between 1950-59, with two in the 4,000-acre category. Since the 1960s, only four

fires larger than 300 acres have occurred in or near Humboldt Redwoods State Park, with none occurring since 1979.

Future Risk

To make a projection of expected future fire occurrence a risk assessment is made using a standard formula. This standard formula is used to calculate risk, based on the number of years of historical information, and the number of acres involved:

$$\text{Risk rating} = [(x/y)*10]/z$$

with x = number of starts recorded for the chosen area

y = period of times records cover

z = number of acres analyzed, displayed in thousands

Risk ratings and ranges of values used in this assessment are shown below.

Risk	Values	Interpretation
Low	0 - .49	At least one fire expected every 20 or more years per thousand acres
Moderate	.5 - .99	At least one fire expected in 11-20 years per thousand acres
High	> 1.0	At least one fire expected in 0-10 years per thousand acres

Table 8. The risk values and ratings indicating trends in measured in risk annually and for the period of 1981-93.

Year	Risk value	Risk rating
1981	1.36	high
1982	.68	moderate
1983	1.22	high
1984	1.75	high
1985	1.88	high
1986	1.20	high
1987	2.02	high
1988	1.52	high
1989	.68	moderate
1990	1.50	high
1991	.93	moderate
1992	.88	moderate
1981-93	1.28	high

The highest risk rating for 1987 was mainly due to arson fires. The projected increase in recreationists, residences, and vacation homes presents a major concern for protecting values and properties within this watershed.

Reducing risk of future fire due to human access can be done through limiting areas of access, annual treatment in areas of high human use, and through public education efforts.

3. Can current public access to BLM lands support the public's need for gathering forest products?

Current public needs for forest products include fuelwood, mushrooms, and beargrass. In recent years, the public's need for these products has increased rapidly. It is not known, at this time, if current access meets current demands. BLM does not currently allow fuelwood gathering in the Red Mountain Management Area. BLM issues permits for gathering beargrass and mushrooms and restricts the gathering of these products to a pre-determined annual number. The environmental impacts of mushroom and beargrass harvesting are not well studied, and current management direction is to be cautious and limit gathering. Permitted gathering of mushrooms and beargrass may be increased or decreased in the future once environmental impacts are further determined. Currently, a need exists to monitor gathering activities and potential impacts.

4. How can BLM facilitate needs for American Indians to access areas of cultural significance?

The Cahto Tribe has areas of cultural significance on Cahto Peak. The BLM needs to arrange a government-to-government agreement in cooperation with the Cahto Tribe for access to these areas. Cahto Peak is also used as for communication equipment sites. The BLM needs to assess needs of the Tribe, communications equipment, and potentially affected environment.

CHAPTER 4
Recommendations

Introduction

This chapter is organized according to the four major issues identified in Chapter Two (Issues and Key Questions). Under each issue, one or more groups of related actions that the Watershed Analysis Team considered important to pursue in subsequent project development are presented, along with related Recommended Actions, Related Strategies, and Data Gaps. The latter are designed as either **critical** or **non-critical** in accomplishing the recommended actions. This chapter represents an interdisciplinary effort to identify realistic ecosystem management priorities for the South Fork Eel River Watershed.

As stated earlier, the focus of this watershed analysis document is on federal lands and federal actions within the watershed. Thus, the following recommendations are centered on those lands in particular.

ISSUE 1: Water Quality

Issue Statement:

How can management actions on federal lands in the South Fork Eel watershed help to maintain or improve the flow of "high quality" water in the South Fork Eel River that supports the desired activities of people?

A. Water quality and scenic value

Key Findings:

The scenic river landscape as well as the water quality are high values for the local communities and for tourists who drive the Highway 101 corridor simply to view the river and its surroundings.

Recommended Actions:

The Bureau of Land Management can contribute to landscape scenic value and water quality in restoration efforts, as well as through the identifying of these two values as high priority criteria in decision-making for other activities on BLM lands within these areas.

Data Gaps:

Non-critical:

To what extent does domestic water use, especially in summer, affect water quality and quantity?

What volume of gravel is extracted from the South Fork Eel River, and what is the effect of the extraction?

B. Water and the economy

Key Finding:

The communities along the South Fork Eel River and Highway 101 corridor have relied on tourism for economic stimulus in the past and its importance to the economy has increased and will continue to increase. In essence, it is the primary economic stimulus. Development of the

region as a whole, utilizing both public and private lands, to deliver a diverse recreation/tourist experience was the primary recommendation identified by a private and public recreation supplier and by individual residents and recreationists during data gathering for this report.

Recommended Actions:

The BLM lands were not considered as contributing significantly to the economy of timber harvesting and very little to the recreation economy. However, BLM has an opportunity to provide a semi-primitive, semi-developed recreation experience which will enhance the various more developed recreation experiences offered by the State Parks and private facilities. This would include providing primitive camping experiences, hiking experiences, and limited access to the river for swimming, boating, and other pursuits. They can also work with private and public providers of recreation experiences to market these opportunities through a recreation guide or through informational data about what is available within the watershed as a whole and how these various facilities link.

With these types of development, it will be essential to launch a public education program regarding the various special designations on BLM lands such as the Wild and Scenic River designation and the closure of fishing along the wild portion of BLM lands. In the Red Mountain area there will be a need to identify ways in which to communicate the significance of various unique plants and how not to impact them.

Data Gaps:

Critical:

In order to effectively plan an overall recreation experience and marketing for the watershed as a whole in conjunction with other recreation providers, there is a need to know the long-term goals and objectives of the State Park system and of private providers. This information is lacking.

ISSUE 2: Anadromous fish

Issue Statement:

In what ways can the South Fork Eel contribute to retaining and ultimately restoring anadromous salmonid stocks in the Eel River Basin?

A. Fisheries and the community

Key Findings:

Water quality and usage as they relate to fisheries are of high value to people in Humboldt and Mendocino Counties. How private and public lands affect management and use of Eel River water is of intense concern. Specifically on the South Fork Eel River, there is concern over water usage and quality, road networks, and catastrophic fire prevention. These issues are of importance to community individuals as well as to the business community.

Recommended Actions:

The health of the Eel River fisheries has generated widespread interest beyond the local communities. A series of meetings called Eel Swap produced a report entitled State of the Eel (1995) that outlines the intense issues and concerns related to Eel River water, as well as issues specific to the South Fork Eel River. This report was the result of efforts that involved numerous

citizens in this interactive process. It is important for BLM to utilize this information and these proposals in their management decisions as much as it is feasible to do so.

Implement BLM Resource Management Plan (RMP) Amendment (BLM, 1995) land tenure adjustment strategy for this area, especially target lands valuable for coho habitat restoration.

Work within the structure of the Northwest Forest Plan to restore native anadromous fish populations.

B. Cooperative restoration

Key Findings:

BLM Key Watersheds are important refugia for anadromous salmonids, especially in context of likely habitat conditions following the next major flood event. However, BLM ownership does not include all land within these Key Watersheds. Opportunities for cooperation with neighboring landowners in restoration and protection of aquatic habitat do exist.

Recommended Actions:

Establish CRMPs for rehabilitation/restoration projects to improve impaired watersheds for the benefit of water quality, resident and anadromous fish, and their habitat.

Related Strategies:

Critical:

The various sub-watersheds within the South Fork Eel River watershed should be examined to assess their condition and to identify problem areas. This will require the gathering of more data on the distribution and quality of fish habitat as well as the relative abundance of fish populations within each sub-watershed. Priority should be given to those sub-watersheds where restoration would be the most beneficial and the chances of success are high. This effort should be done with input from private landowners and state land managers, as well as from other state and federal agencies. Once identified, the owners and managers of lands in the sub-watershed should attempt to establish a CRMP that would identify and execute the best restoration strategies.

Provide education programs and other public outreach to let the public know what is available for road construction or maintenance. Promote the transfer - to rural landowners - of technical information on the effects of poor road construction and improper or lack of maintenance on streams and aquatic species.

Related Strategies:

Non-critical:

Resource Conservation Districts (RCDs) have access to grant monies not available to individuals and can act on behalf of landowners. RCDs also have expertise in road design and maintenance. Mendocino County RCD published the Handbook for Forest and Ranch Roads, by Dan Hagans and Bill Weaver, which is a good resource for rural road design and maintenance.

Key Findings:

Although BLM Key Watersheds in the South Fork Eel River watershed are expected to contain high quality habitat for anadromous salmonids, existing abandoned roads and existing drainage problems on roads could contribute to some habitat degradation following the next large flood event. In addition, other potential sediment sources should be analyzed for potential restoration.

Recommended Actions:

BLM needs to undertake an analysis of all existing roads on public lands within the Red Mountain Management Area. This analysis should identify priorities for treatment of abandoned roads and improvements to drainage on maintained roads.

The lower two miles of Red Mountain Road should have drainage improvements and be surfaced to eliminate a large volume of fine sediment from the aquatic system.

The Hermitage Road should be gated to prevent illegal access on this un-maintained road which could increase erosion.

Inventory landslides for possible stabilization work.

Consider gating Judge's Jeep Road to reduce fire hazard and erosion while maintaining access for fire suppression.

Related Strategies:

Critical:

Consider limiting access to spur roads to limit fire hazard and erosion.

Data Gaps:

Critical:

An analysis of all roads and sediment sources in the Red Mountain Management Area should be conducted prior to initiation of restoration work.

ISSUE 3: Threatened, endangered and special-status species recovery

Issue Statement: What is the significance of the South Fork Eel River in sustaining Threatened, Endangered and Special Status (TES) plant and animal species and their habitats, as well as contributing to the recovery of previously more abundant species?

A. Late-Successional Reserve improvement

Key Findings:

Currently, only a small portion of the landscape has late-successional forest characteristics compared to probable historical conditions. In addition to the natural fragmentation, human activities have increased the fragmentation of the forest landscape. The recovery of many TES species depends upon adequate distribution of late-successional habitat throughout the landscape. LSRs in federal ownership (along with State Parks) are key starting points in the recovery of many TES species. Given the current conditions of LSRs in the watershed, needs for improvements are recognized.

Recommended Actions:

Accelerate development of functional suitable habitat with thinning and intermediate silvicultural prescriptions.

Improve LSRs by decreasing fragmentation via acquisition or land exchanges within LSRs using Matrix lands as specified in BLM RMP Amendment (BLM, 1995).

Perform surveys for LSR species, particularly northern spotted owl and marbled murrelet.

Reduce fire risk and maintain suitable habitat in LSRs.

Perform prescribed fire maintenance (ridgeline stands).

Improve riparian habitat quality to ensure survival of native fishes and amphibians.

Develop LSR Assessment.

Fulfill ROD requirements for Survey and Manage species.

Monitor peregrine falcon sites.

Related Strategies:

Critical:

Conduct vegetation classification to include downed wood and snags.

For LSRs, consider fuels reduction near roads through fuelwood cutting.

Consider developing management guidance for species found on public lands.

Cooperation among California Department of Fish and Game, U.S. Forest Service and U.S. Fish and Wildlife Service.

Data Gaps:

Critical:

Need vegetation classification to series sub-series, and successional stages; include downed wood and snags.

Obtain baseline stand data for snags and coarse woody debris (or fuel loading).

Complete road inventory and sediment source inventory.

Monitor occupied and highly suspected peregrine falcon sites.

Monitor northern spotted owl and peregrine falcons.

Monitor silvicultural treatments.

Monitor post-fire vegetation conditions.

Survey and inventory for TES and Survey and Manage species likely to occur in the South Fork Eel River watershed.

B. Ecosystem sustainability

Key Findings:

Late-Successional Reserves were established in the Northwest Forest Plan as a system of forest reserves in which to anchor recovery of old-growth dependent species including the northern spotted owl (NSO) and marbled murrelet (MAMU). Within the South Fork Eel River watershed, BLM lands comprise a very small fraction of the total watershed acreage, but 97 percent of those lands are in LSRs. BLM needs to take proactive management actions for these lands to help attain recovery of NSO and other species.

Recommended Actions:

Monitor NSO activity centers, and vacant/adjacent federal suitable habitat.

Reintroduce fire into fire-maintained brush and grassland communities.

BLM cooperation with California Department of Fish and Game and U.S. Fish and Wildlife Service to identify high priority exotic species for control.

Cooperate/help establish education program to help reduce future introductions of exotics.

Manage habitats to reduce influence of exotic species.

Data Gaps:

Non-critical:

Monitor barred owl expansion of range and numbers.

Monitor occupied red-legged frog habitat, and impacts of bull frog (expansion of range).

C. Fire hazard assessment

Key Finding:

The fuels situation in the South Fork Eel River watershed presents the possibility of high-to-extreme fire behavior, especially under late summer conditions. Large contiguous areas of hazardous fuels situations exist throughout the watershed, sometimes in close proximity to high risk areas along major highways. Also, stand density has increased, resulting in ladder fuels which create the potential for crown fires and resulting tree mortality and habitat destruction. Devastating wildfires could also be one of the major risks to the riparian ecosystem, either through the removal of overstory vegetation (and the resulting increase in water temperature) or through increased sediment from resulting erosion.

Recommended Actions:

Consider and implement appropriate fuel treatments based on site-specific assessments of wildfire risk, hazard, values, and the needs of other resources.

BLM needs to update the fire plan for the South Fork Eel River watershed in coordination with the Angelo Preserve.

Related Strategies:

Critical:

Given the current situation of extensive areas with the potential for high-to-extreme fire behavior within a highly inhabited and trafficked area, initial attack for all wildfires should be an aggressive suppression strategy.

When selecting an appropriate suppression response, firefighter safety must remain the highest concern. In addition, fire managers must be assured that planned actions will be effective and will remain effective over the expected duration of the fire. Suppression actions should use strategies and tactics that strive to protect the specific attributes of the various land allocations and resource concerns within the watershed. Whatever strategy is selected, the emphasis should be on low impact suppression tactics wherever feasible.

Non-critical:

The California Department of Forestry needs to more aggressively pursue its Vegetation Management Program to promote the use of more prescribed burning on private land. Vegetative management and/or natural fuels reduction needs to be considered throughout the watershed, taking into consideration potential risk, hazard, and values. Removing ladder fuels (through

thinning, mechanical treatment, or understory burning) could reduce the potential for crown fires.

Combinations of fuelbreaks, vegetation mosaics, and project-level treatment would be more cost effective than project-level treatment alone. Strategically-placed shaded fuelbreaks could be used to help reduce the impacts of wildland fires and help in the implementation of planned understory burning projects.

The use of prescribed fire is currently the most economical treatment method available for managing forest fuels. In some cases, to achieve environmentally and ecologically sensitive objectives, alternative, more expensive fuel treatment methods — such as hand-piling and/or rearrangement of fuels — will need to be implemented. Also, hazard reduction objectives may be satisfied through biomass utilization (if there is a market demand) or stand structure manipulation. These alternative fuel treatments may be used in combination with prescribed burning in order to reduce the fuel loading to acceptable levels, prior to burning.

Fuel treatments, alternative suppression strategies, and silvicultural techniques need to be investigated with the goal of returning to "natural" fire regimes of frequent, low-intensity fires. Pre-attack planning should also be addressed to determine the need and placement of water sources, helispots, communication links, etc.

Resource management activities should be designed and implemented so that the wildfire hazard level of the surrounding area is not increased to an unacceptable level. Concentrations of fuels created by management activities should be reduced to acceptable levels and arrangements based on the site-specific wildfire risk and the needs of other resources.

Specific situations (beyond those already mentioned for Humboldt Redwoods State Park) that could benefit from fuel treatment activities include:

near high use areas (campgrounds, and dispersed recreation sites);

brush Mountain, Elkhorn Ridge, and Cahto Peak;

near residences and on private property;

near and within critical wildlife areas (e.g., 100-acre LSRs);

along heavily-used highways and roads, ridges, and plantations;

areas with untreated fuels from past management activities;

oak woodlands to deter conifer encroachment and provide acorns for American Indians; and,

the Angelo Coast Range Preserve.

Data Gaps:

Critical:

Wildfires do not respect either watershed or administrative boundaries. Therefore, further analysis and discussion with cooperating agencies and adjacent landowners would be necessary to determine fire hazard and associated effective fire suppression and fuel treatment strategy for the South Fork Eel River watershed.

Our data on fire regimes (distribution, intensity, and frequency) is somewhat limited for this area. Prior to our fire reporting period from the 1980s, fire frequency data is lacking. Further data analysis would be necessary to determine the fire regime for this watershed.

Models such as FOFEM (First Order Fire Effects Model), which assess mortality based on species, trees/acre, d.b.h., tree height, and flamelengths, should be investigated by seral stage to determine potential effects of wildfires versus. prescribed fires. Fire monitoring plots should be initiated in the watershed in selected vegetation types of interest (e.g., oak woodlands) to assess the short- and long-term effects of fire on the ecosystem. The preferred protocol would be that developed by the Western Region of the National Park Service, which collects data to document basic information, to detect identified trends, and to ensure that fire and resource management objectives are met (National Park Service, 1992).

ISSUE 4: Access

Issue statement: What strategies should the Bureau of Land Management follow in managing access to federal lands in the South Fork Eel Watershed?

A. Consultation with Cahto Tribe

Key Finding:

The Cahto are a Federally Recognized Tribal Government, a designation that requires the BLM to consult with their elected officials and to meet any Trust responsibilities that may exist. The Cahto have identified religious, cultural, and archaeological resources within BLM lands that are significant to them. Currently, there does not exist an interactive government-to-government relationship between the Cahto and the BLM. This relationship can be an impetus for resolving these issues and enhancing tribal economic endeavors.

Recommended Action:

The Bureau of Land Management and the Cahto Tribe can meet to develop a formal agreement for consultation regarding resources and management activities that may affect both. This consultation process should allow for the identification of locations of culturally and socially significant resources and allow for consultation concerning how best to meet the needs of the Cahto as they relate to these resources.

Data Gaps:

Critical:

The Sinkyone were aboriginal users of this watershed, and data is lacking as to any contemporary values that may still exist.

B. Fire risk trend

Key Finding:

Human-caused risk has been moderate-to-high in this watershed for at least the last 15 years. The majority of human causes are attributed to arson, miscellaneous (including burning building, industry, lumbering, resident), and debris burning. Transportation access plays a major role in the majority of these human fire starts. BLM acquisition of public access at the Hermitage Road will likely result in a growing number recreationists and forest product gatherers in the Wild and Scenic portion of the South Fork Eel watershed area could result in increased fire starts, either intentional or accidental. A catastrophic fire in this portion of the watershed could severely damage late-successional forest habitat important for recovery of TES species.

Recommended Actions:

Prior to opening the Hermitage Road for public access, BLM should take steps to reduce fuels in this portion of the watershed, especially near trail systems and associated camping sites.

In conjunction with the proposed trail system, establish, and require camping in, designated primitive camp sites with fire rings. Clear campsites of fuels annually.

Public education about fire risk should be conducted via kiosks placed at access points.

Related Strategies:

Critical:

Strategically placed fuels treatment, including cooperative fuels treatment, involving private landowners and the California Department of Forestry and Fire Protection, should be investigated in areas of potentially high hazard and risk. To deal with the urban wildland intermix, a strategically placed fuelbreak system could provide defensible locations to stop wildfires from and reduce the threat to private lands from fires originating on federal lands.

C. Recreation Use

Key Finding:

BLM acquisition of access at Hermitage Road will likely result in increased recreation use of the Wild and Scenic section of the watershed. Besides increased fire risk, other impacts from recreation use could occur, however these can be minimized through management actions.

Recommended Actions:

BLM needs to monitor recreation impacts in this portion of the watershed starting when (or if) the proposed public access is opened. A recreation use monitoring plan should be developed and implemented at this time.

BLM should design and install a vehicle crossing over Rattlesnake Creek that will afford dry weather access to the proposed parking area that will meet with Aquatic Conservation Strategy objectives.

Roads, trails, and other recreation facilities should be clearly signed.

Related Strategies:

Critical:

Follow ROD Standards and Guides for locating new recreation facilities within riparian reserves.

REFERENCES

Brown, L. R. and P. B. Moyle. 1990. Eel River Survey: Final Report. California Department of Fish and Game, [Contract: F-46-R-2].

California Department of Fish and Game. Unpublished data.

Detrich, Phillip J. and D. K. Garcelon. 1986. Criteria and habitat evaluation for bald eagle reintroduction in coastal California. Final report to California Department of Fish and Game, Wildlife Management branch, [Contract C-1307], Sacramento, CA. 32 pp.

Downie, Scott, and D. Fuller, L. Chapman. 1995. State of the Eel 1995. An overview of the Eel Basin with Current Issues, Questions, and Solutions. Summarized from Eel Swamp Meeting March 25, 1995. California Department Fish and Game, Bureau of Land Management, Six Rivers National Forest. Redway, Arcata, Eureka, California.

FR 59:22, Feb. 2, 1994. Proposed listing of the red-legged frog [sub-species *Rana aurora draytonii*].

Kupferberg, Sarah J. 1995. Bull frog (*Rana catesbiana*) invasion of a California river: the role of larval competition. Department of Integrative Biology, University of California, Berkeley. Berkeley, CA, 52 pp. and figures.

Lisle, T. E. 1982. The recovery of stream channels in north coastal California from recent large floods. In: K. A. Hashhagen (ed.). Habitat disturbance and recovery, proceedings of a symposium. California Trout Inc., San Francisco, CA. Pp. 31-42.

Lufkin, A. 1991. California's salmon and steelhead: the struggle to restore an imperiled resource. University of California Press, Berkeley, California. 305 p.

National Marine Fisheries Service. 1995. Endangered and threatened species: proposed threatened status for three contiguous ESUs of coho salmon ranging from Oregon through central California. 50 CFR, part 227.

Six Rivers National Forest and Bureau of Land Management Arcata Resource Area. 1996. North Fork Eel River Watershed Analysis, Version 1.0, June, 1996.

USDA Forest Service and USDI Bureau of Land Management. 1994. Final Supplemental Environmental Impact Statement on management for late-successional and old-growth species within the range of the northern spotted owl. Portland, OR.

USDA Forest Service and USDI Bureau of Land Management. 1994. Record of decision for amendments to Forest Service and Bureau of Land Management planning documents within the range of the northern spotted owl, and standards and guidelines for management of habitat for late-successional and old-growth species within the range of the northern spotted owl. Portland, OR.

Welsh, H. H. and A. Lind. 1991. The structure of herpetofaunal assemblage of the Douglas-fir forests of northwestern California and southwestern Oregon. In L. Ruggerio, K. Aubrey, A. Carey, and M. Huff (tech. coordinators), Wildlife and vegetation of unmanaged Douglas-fir forests, pp. 394 - 413. USDA Forest Service General Technical Report PNW-285. Pacific Northwest Experimental Station, Portland, OR.

Wooton, J. Timothy and D. A. Bell. 1992. A metapopulation model of the peregrine falcon in California: viability and management strategies. Ecological Applications, vol. 2, no. 3, pp 307 - 321.

Zeiner, et al. 1988. California Wildlife, vol. 1. Amphibians and Reptiles, vol. 2, Birds. Mammals, vol. 3. California Department of Fish and Game, Sacramento, CA. Pp. 272, 732, and 407, respectively.

Acronym Definitions

ACRP - Angelo Coast Range Preserve

ACEC - Area of Critical Environmental Concern

BLM - Bureau of Land Management

CDFG - California Department of Fish and Game

CDF - California Department of Forestry

CalTrans - California Department of Transportation

CNPS - California Native Plant Society

CRMP - Cooperative Resource Management Plan

FSEIS - Final Supplemental Environmental Impact Statement

LSR - Late-Successional Reserve

MIST - Minimum Impact Suppression Tactics

NWFP - Northwest Forest Plan

PSW - Pacific Southwest Research Station

RCD - Resource Conservation District

RMP - BLM Resource Management Plan

ROD - Record of Decision

TES - Federally-listed as threatened, or endangered, or a Forest Service sensitive species

TTF - Timberland Task Force (vegetation data compiled from satellite images

UC - University of California

USFWS - U. S. Fish and Wildlife Service

WHR - Wildlife Habitat Relationships

APPENDIX A

Appendix A

A Comparison of BLM Data to the Timberland Task Force (TTF) Data in the South Fork Eel Watershed.

Introduction:

No accuracy assessment was done on the TTF data that covers the South Fork Eel. Because of this lack of accurate field verification there appear to be several problems with this data. It was noted during field visits, that the area around Red Mountain does not have the extent of redwood shown in the TTF data. The canopy closure data also does not appear to indicate the amount of harvesting that is known to have taken place in this watershed. There is also a technical problem that is displayed as a line delineating the southern 95,000 acres from the rest of the watershed. This line is the result of two separate landsat themes taken at different times of the year. Because of the distinct difference between these two sections the southern portion was deleted from the analysis.

To further test the accuracy of the TTF data a comparison was made between this data set and the BLM data. The assumption of this comparison is that the BLM data is more accurate since it has been field reviewed. One problem with this comparison is the difference in scale between the two data sets. The minimum polygon size for the TTF data is 40 acres the minimum polygon size for the BLM data is believed to be 5 acres. Despite this difference in scale some degree of association is expected since both data sets use the WHR vegetation classification system.

Methods:
Overlays of BLM data and the TTF data were done in arc-info. Tabular information was examined in an Excel spreadsheet. Comparisons were made for three attributes: the WHR vegetation type, size class, and canopy closure.

Results:

As expected areas with small patch sizes such as grasslands, barrens and shrubs did not correlate well with the TTF data. Most of these vegetation types correlated with the Montane hardwood conifer WHR type in the TTF data set (Table). Vegetation types such as Douglas-fir and Mixed conifer which were expected to correlate with the TTF data did not. Again most of the Douglas-fir types correlated with Montane hardwood conifer. This correlation would seem reasonable if there was a high amount of hardwood in the Douglas-fir type on BLM land, but according to BLM personnel this is not the case. The mixed conifer type on BLM land was expected to correlate with Klamath mixed conifer but did not. Most of the types identified on BLM land were classified as Montane hardwood or Montane hardwood conifer in the TTF data set.

There was virtually no relationship between the two data sets for size class and canopy closure. The size classes in the BLM data were primarily associated with size class 11-23.9" in the TTF data set. The canopy closure classes in the BLM data corresponded primarily to

the >60% canopy closure class in the TTF data. It is suspected that the TTF data overestimated canopy closure for most of this watershed and underestimated in some cases the size class.

BLM WHR type	Expected WHR type (TTF)	Actual WHR type (TTF)
BR (brush)	SHR (shrub) (1%)	MHC (49%)
BS (baresoil)	BAR (barren) (12%)	MHC (40%)
D (Douglas-fir)	DFR (Douglas-fir) (26%)	MHC (50%)
GR (grass)	HRB (herb) (-)	MHC (29%)
H (hardwood)	MHW (montane hardwood) (8%)	MHC (58%)
LO (live oak)	MHW (montane hardwood conifer) (59%)	ok
M (mixed conifer)	KMC (Klamath mixed-conifer) (15%)	DFR (73%)
P (ponderosa pine)	PPN (ponderosa pine) (9%)	JPN (30%)
TO (tanoak)	MHC (39%) or MHW (60%)	ok
WO (white oak)	MHC (48%) or MHW (48%)	ok
RI (river)	WAT (water) (1%)	MHC (36%)

Table . The percent relationship between BLM closure classes and TTF closure classes in the South Fork Eel watershed

BLM closure class	acres	TTF closure class D >60%	M 40-59.9%	P 25-39.9%	S 10-23.9%	N 0.00%
D=60-100%	11,464	87%	10%	2%	0.21%	1%
M=40-59%	3,835	83%	12%	4%	0.26%	0.21%
P=25-39%	8,845	58%	13%	18%	7%	4%
S=10-24%	887	89%	7%	2%	0.07%	1%
N=0	3,972	69%	21%	6%	2%	3%

*does not include undefined acres

Table . The percent relationship between BLM whr vegetation types and TTF whr vegetation types in the South Fork Eel watershed

BLM		TTF whr														
whr type	acres	BAR	CPC	DFR	HRB	JPN	KMC	MHC	MHW	PPN	RDW	SHR	UND	URB	WAT	WFR
Brush (BR)	2,966	0%	-	12%	-	1%	6%	49%	31%	0%	1%	1%	0%	-	-	-
Bare soil (BS)	121	12%	-	-	-	1%	11%	40%	31%	-	-	6%	0%	-	-	-
Douglas-fir (D)	8,980	0%	-	26%	0%	0%	3%	50%	20%	0%	1%	0%	0%	26%	26%	26%
Grassland (GR)	212	4%	-	7%	-	4%	24%	29%	13%	1%	-	18%	-	-	1%	-
Hardwood (H)	9,558	0%	0%	24%	0%	0%	5%	58%	8%	0%	3%	0%	0%	0%	0%	0%
Live Oak (LO)	574	-	-	1%	-	-	-	39%	59%	1%	-	-	-	-	-	-
Mixed conifer (M)	28	-	-	73%	-	-	15%	10%	-	1%	-	-	-	-	-	-
Non-commercial (NC)	84	-	-	33%	-	-	20%	33%	15%	-	-	-	-	-	-	-
Non-forest (NF)	342	-	-	17%	0%	-	34%	40%	9%	0%	0%	-	-	-	-	-
Ponderosa pine (P)	3,777	2%	2%	3%	-	30%	25%	18%	4%	9%	-	8%	0%	-	0%	-
Tanoak (TO)	1,818	-	-	1%	-	-	0%	39%	60%	-	-	0%	0%	-	-	0%
white oak (WO)	296	-	-	3%	-	-	0%	48%	48%	-	-	1%	-	-	-	-
River (RI)	250	2%	3%	11%	2%	0%	17%	36%	8%	0%	8%	-	1%	-	1%	-

* BR includes NF-BR and NT-BR, BS includes NF-BS, GR includes NF-GR, RI includes NF-RI

**Does not include undefined acres

Table . The percent relationship between BLM size classes and TTF size classes in the South Fork Eel watershed

BLM		TTF size class 0	<6"	6-10.9"	11-23.9"	24-35.5"	>36"
size class	acres	0					
*0=no size class	6616	-	-	-	-	-	-
1=<1"	155	-	-	36%	58%	6%	-
2=1-6"	6,285	1%	0.18%	12%	73%	12%	1%
3=6-11"	4,774	0.28%	0.37%	13%	72%	12%	2%
4=11-24"	8,176	4%	0.15%	10%	78%	6%	1%
5=>24"	5,617	1%	0.12%	8%	67%	21%	3%
6=multi-canopy	25	-	-	0.12%	99.92%	-	-

*no comparison was made for acres without a size class

APPENDIX B

Appendix B TE AND SPECIAL STATUS WILDLIFE SPECIES FOR THE EEL RIVER BASIN

Threatened and Endangered Species

Marbled Murrelet

Northern Spotted Owl

American Peregrine Falcon

Bald Eagle

Aleutian Canada goose

Scattered flocks of Aleutian Canada geese use the Eel River estuary and bottom land pastures during migration (late October to November), and winter (Harris 1991). Although insufficient wintering habitat is one of the greatest obstacles to recovery, the Eel River probably does not constitute a vital staging or wintering area for this species.

Western snowy plover

The Pacific coast population of the western snowy plover is threatened throughout its range by loss and disturbance to its coastal beach nesting sites. Based on the most recent surveys, a total of 28 breeding sites or areas occur on the Pacific coast, with 20 breeding areas currently in coastal California. Snowy plovers are known to nest on both sides of the Eel River mouth (H. Pierce, pers. comm.). The USFWS has proposed Critical Habitat for the snowy plover that includes the spits and beaches from Table Bluff south to the mouth of the Eel (CA-2, unit 1), and from the mouth of the Eel south to Centerville Beach (CA-2, unit 2) (60 FR 11768) (Figure ??).

This species continues to be threatened by habitat loss due to encroachment of European beachgrass (*Amophila arenaria*) and coastal development. Predation and human activities that disturb or trample eggs and chicks also contribute to the low rate of nesting success. Nesting success has improved through area closures or fencing nests.

California brown pelican

The California brown pelican uses the south spit and the sand bars inside the estuary mouth during late summer and fall for a day-time roost. This roost area is considered of moderate importance to the species. Twelve surveys of the Eel River estuary conducted from 1980 to 1988 averaged 77 pelicans with peak numbers of 335 in October and July (D. Jaques, pers. comm.).

Brown pelicans select roosts that have : 1) isolation from people and other mammalian predators; 2) a water barrier between them and disturbances; 3) shelter from wind; and 4) proximity to foraging. Possible threats to this roost are: 1)increased sedimentation/siltation; 2) pollution/contamination; 3) water diversion; and 4) human disturbance/development (D. Jaques, pers. comm.).

Tidewater goby

The tidewater goby is uniquely adapted to coastal lagoons and the uppermost brackish zone of larger estuaries. This species has not been recorded from the Eel River estuary but has been taken in small numbers in a few areas in Arcata Bay. The Draft Recovery Plan for the tidewater goby calls for surveys in the interconnected Eel River estuary, Mad River estuary, and southern Humboldt Bay to establish the extent and status of populations and to help formulate management objectives for this locality (USFWS 1995). Habitat modification of coastal wetlands continues to be the primary reason for the decline of this species

Lotis blue butterfly

The lotis blue butterfly is known from only a few isolated bogs in Mendocino County (41 FR 22041). Although this species is not known to occur in the Eel River basin, it should be looked for if conducting surveys (D. Wright, pers. comm.).

Forest Service Sensitive Species

Great Gray Owl (also a Protection Buffer species, see ROD page C-21)

The great gray owl is not known to occur in the Eel River Basin but surveys should be conducted in suitable habitat. Suitable habitat consists of mature and old-growth red fir, mixed conifer, or lodgepole pine forests adjacent to large meadows at 4500 to 7500 feet elevation. This type of habitat is limited in the Eel River Basin, although high elevation meadows in the ???? area may be suitable. This species appears to be declining in California.

Northern Goshawk (also a USFWS Species of Concern)

The northern goshawk is an uncommon raptor that uses a wide variety of forested habitat. In northern California they prefer middle and higher elevation, older pole-sized, mature, and old-growth conifer forests with relatively dense canopy closures, usually little under story vegetation, close proximity to riparian corridors, and flat or moderately sloping terrain. Moderate and high quality habitats contain abundant large snags and large logs for prey habitat and plucking perches (Hall 1984).

In addition to habitat included in Late Successional Reserves, the Six Rivers National Forest has a network of managed goshawk territories established around ??? known activity centers in the Eel River basin. There have been sightings of goshawks within the basin and ??? reproductive territories are known to occur.

This species is considered to be declining in numbers and distribution over the past several decades. Factors cited as contributing to this decline have included alterations in habitat distribution patterns and in availability of suitable habitat.

Little Willow Flycatcher (also a USFWS Species of Concern)

The willow flycatcher prefers wet meadows or riparian zones dominated by willow with open areas for foraging. It has been extirpated as a breeding bird from most of its California range. This decline has been attributed to habitat loss, cowbird parasitism, livestock grazing, loss of meadow habitat due to hydroelectric power development, and pine encroachment in

meadows (Harris et. Al. 1986, Serena 1982).

There is little evidence of current breeding in the Eel River Basin but this area has not been adequately surveyed. Two birds heard singing on 9 July, 1982 in the Ferndale bottoms are highly suggestive of breeding behavior (Kelly 1982). The Eel River estuary probably is a regular migrant stop for this species (S. Harris, pers. comm.).

Pacific Fisher (also a USFWS Species of Concern), American Marten and Wolverine (USFWS Species of Concern)
Pacific fishers are associated with low and mid-elevation forests between 2,000 and 5,000 feet in this region. They occur in varying stand ages with closed canopies, snags, and large, down coarse woody debris. Dense riparian corridors or other landscape patterns are used as adult and juvenile dispersal corridors.

American martens are adapted to higher elevation conditions than are fishers. Martens are closely associated with late-successional forests, down coarse woody debris, and intact forest along riparian corridors used as travelways.

Wolverine use a variety of habitats including Douglas-fir, mixed conifer, red fir, lodgepole, wet meadow, and montane riparian habitats from 1600 to 4800 feet. There are no confirmed sightings of wolverine in the Eel River Basin but a few possible sightings have occurred in the north coastal region.

Habitat for these three species are included within Late Successional Reserves. Six Rivers National Forest, in cooperation with the Redwood Sciences Lab and California Department of Fish and Game, is conducting forest carnivore track plate surveys along several west to east transects. Numerous or heavily traveled roads increase mortality and disrupt movements of all three furbearer species.

Northwestern Pond Turtle (also a USFWS Species of Concern)
The northwestern pond turtle is discussed under the following section Herpetofauna.

Special Status Species (see Table 3; Special Status species include USFWS Species of Concern [formerly Category 2 Candidates], USFS Sensitive Species [discussed above], Survey and Manage and Protection Buffer species listed in the ROD)

White-headed Woodpecker, Flammulated Owl, and Pygmy Nuthatch
These three species have additional standards and guidelines incorporated in the ROD from the SAT report (see ROD, pp. C-45 to C-47) . The white-headed woodpecker is thinly distributed throughout higher inland montane pine and fir forests with large trees and snags.

Flammulated owls are secondary cavity-nesters that use cavities in snags and live trees. They are considered a rare to uncommon summer resident and breeder on inland ridges in this area (Harris 1991). Territories occur in loose colonies in mixed woodland containing either ponderosa or Jeffrey pine or California black oak (Marcot and Hill 1980). Both the white-headed woodpecker and flammulated owl have been observed in similar habitats in the

Middle Fork and the Main Stem Eel (B. Kieffer, pers. comm.).

The pygmy nuthatch uses mature ponderosa and Jeffrey pine habitat and require cavities in trees or snags for roosting and nesting. There is one known historical record of pygmy nuthatch occurring at Mt. Sanhedrein, east of Willets, in 1919 (S. Harris, pers. comm.).

Del Norte Salamander

The Del Norte salamander, a survey and manage species (ROD page C-28), is discussed under the following section Herpetofauna.

White-footed Vole and California Red Tree Vole

Both species of voles are USFWS species of concern and occur in coastal mature and old-growth redwood, Douglas-fir or mixed evergreen forests. Preferred habitat for the white-footed vole also occurs in the vicinity of small, clear streams with dense vegetation for cover, however this species has not been recorded south of Arcata. The red tree vole is believed to be almost exclusively a canopy dweller. There is uncertainty about both species distribution, habitat requirements, and population status.

Bats

Eight species of Special Status bats are known or suspected to occur in the Eel River basin (Table 3)(Zeiner et al., 1990). These eight species are listed in Appendix J2 of the FSEIS ROD and/or are USFWS Species of Concern. They fall into four groups: 1) small, nonmigratory, crevice-roosting bats with widespread distributions that use snags, decadent trees, buildings, bridges, and caves for roosting and hibernating (long-eared myotis, fringed myotis, long-legged myotis, Yuma myotis, pallid bat); 2) hoary bat (large, solitary, migratory, obligatory foliage-roosting bat with a widespread distribution); 3) silver-haired bat (large, migratory, widely-distributed, snag and decadent tree-roosting bat [may occasionally use buildings and caves for roosting]); and 4) Pacific western big-eared bat (coastal subspecies, nonmigratory, uncommon, extremely sensitive to disturbance of roosting sites, requires caves, mines, tunnels, buildings or other human-made structures for roosting) (FSEIS Appendix J2).

Although no specific surveys for bats or their habitats have been completed in the Basin, there have been demonstrated and hypothesized decreases in bat populations throughout this region (Pierson 1988, Gellman and Zielinski, in press). Decreases in bat populations are thought to be due largely to loss of roosting habitat and to disturbance. There is strong concern that loss of snags and decadent trees from widespread cutting of old-growth forests, destruction of caves and mines, demolition of old wooden bridges and buildings, and human disturbance have significantly reduced the availability of potential roost sites for all these species. Since these species also forage over riparian zones, there is concern that previous timber harvest practices and over-grazing have reduced this foraging habitat (Hayes et al.,1995). Long term vegetation changes may have significant impacts on bats if the original riparian vegetation is a critical component in the life cycles of the bats preferred prey species (Idaho State Conservation Effort, 1995).

Herpetofauna

Numerous reptiles and amphibians are dependent on riparian habitat. The northwestern pond

turtle, tailed frog, red-legged frog, foothill yellow-legged frog, and southern torrent salamander are sensitive riparian-dependent species, that are known to occur in the Eel River basin. Surveys have been limited but have occurred in the North Fork, South Fork and Van Duzen watersheds (Appendix __).

The **northwestern pond turtle** inhabits a wide range of fresh or brackish,, permanent and intermittent water bodies throughout the Eel River Basin. Adult turtles are habitat generalists, whereas hatchlings and juveniles have relatively specific habitat requirements which are often very limited and susceptible to disturbance. This species requires protruding or floating woody debris or rocks, emergent and overhanging vegetation, underwater cover in the form of logs, debris piles, aquatic vegetation, or rock crevices. For nesting and overwintering, turtles require an adjacent terrestrial area (within 500 m of the watercourse) with uncompacted soil and a duff layer (Jennings et al. 1993).

Although pond turtles have been eliminated from an estimated 30-40% of their historical range, habitat conditions and population trends are unknown in the Eel Basin. Major threats to this species are loss or alteration of habitat (including wetland reclamation, water diversions, dams, and grazing), fragmentation of habitat, over exploitation, and spread of exotic species (especially bullfrogs and bass) (Jennings et al. 1993).

Tailed frogs generally are found in cold, rocky, fast-flowing streams in humid forests of Douglas-fir, pine, spruce, redwood, maple, alder, and bay with at least 45% canopy closure. It is a slow growing species that spends five to six years in larval stage. Tailed frogs cannot tolerate high water temperatures or siltation but have been found in unforested segments of a stream, provided low water temperatures are maintained (e.g. undisturbed forests upstream). Threats include increased stream temperatures, increased siltation, and decreased water oxygenation. Although few surveys have been conducted, this species is known to occur in the North Fork and Van Duzen watersheds.

Northern red-legged frogs found in Humboldt to northern Marin County exhibit intergrade characteristics betwen northern *(Rana aurora aurora)* and California (*R. a. draytonii*) red-legged frogs. California red-legged frogs occur from Point Reyes National Seashore south to Baja California, while northern red-legged frogs occur from British Columbia, Canada south to Del Norte County, California (59 FR 4888). There are some clear differences in behavior and habitat preferences between the two subspecies.

Northern red-legged frogs require ponds, pools in slow streams, marshes, or reservoirs with submergent vegetation for egg attachment, a depth of greater than 1 meter to accommodate singing males, and a minimum stream width of greater than 2 meters. This frog is found in coniferous/mixed hardwood forests with greater than 50% canopy closure with downed logs in and out of the water. It requires cool water, having the lowest upper (21 C) and lower (4 C) lethal embryonic temperature of any North American ranid frog (Licht 1971).

Threats to this species are similar to those discussed under the northwestern pond turtle (e.g. loss, fragmentation or alteration of habitat resulting in increased water temperatures, decreased pool depths, or decreased riparian vegetation; and introduction of exotic fishes or bullfrogs.

The **foothill yellow-legged frog** inhabits rocky, higher gradient, shallower streams with less vegetative stream side cover than do red-legged frogs. Both species require partially submerged rocks and logs for basking and cover. Yellow-legged frogs apparently are more widespread and numerous in the Eel Basin than are red-legged frogs. The yellow-legged frog population is considered stable in the north coast area.

Southern torrent salamanders reside in headwaters, springs, seeps, and first to third order streams with high canopy closure. This species is an aquatic obligate, sensitive to desiccation, increased sedimentation, and habitat alteration. Torrent salamanders require cold water temperatures, consistently 8 - 12 degrees in summer. Their headwater stream habitat has declined substantially due to extensive logging.

Del Norte salamanders reside in talus and rocky substrate slopes protected by over story canopy that maintains cool, moist conditions on the ground. Some studies show an association between the occurrence of this species and old-growth forests (Welsh and Lind 1988); while other researchers show forest stand age is not critical as long as moisture is abundant and temperatures are moderate, as in coastal areas (Diller 1994). The Del Norte salamander has not been located south of Township 5N (roughly south of the Mad River), where it is apparently replaced by the black salamander (*Aneides flavipuncta)*(L. Diller, pers. comm.). Although not expected in the Eel River Basin, the necessity for surveys can be determined based on development of survey protocol and distance from the nearest known sighting.

Appendix B : AMPHIBIANS

1. Have any amphibian inventories been done on a project or watershed level? What species does literature suggest may be present in the watershed?

North Fork

A herpetofauna survey of the North Fork Eel was conducted in 1995 as part of the SRNF Riparian Inventory to integrate vegetation, geomorphological, and wildlife data to analyze riparian habitat communities (Wicktor 1996). Twenty one, out of 34 expected species, were seen. Northern red-legged frogs were not observed during this study but have been seen on Big Bend Ranch in the southern portion of the watershed (Leopardo 1994).

South Fork

A study was conducted by Pacific Southwest Research Station from 1984-1986 to determine the occurrence and abundance of the forest herpetofauna relative to forest age and moisture in 42 stands of Douglas-fir/hardwood forest in southwestern Oregon and northwestern California (Welsh and Lind 1991). Species diversity was greater in older forest stands and amphibians were significantly more abundant in older stands than in younger stands. Twenty seven study sites occurred in the southern part of the South Fork Eel watershed near Branscomb: 13 aquatic sites and 14 terrestrial sites in forests ranging from young to old-growth. Twelve amphibian species were detected in the South Fork.

Numerous research studies involving herp species have occurred in the Heath and Majorie Angelo Coast Range Reserve (Hemphill and Worthey-Baumer 1993, Parker 1991, 1992, 1993, 1994, Kupferberg 1993, 1994, 1996) . Eleven species of amphibians are known to occur in the Reserve (Mackey 1981). Competition and predation between bullfrogs and native frogs have been studied since bullfrogs first appeared in this pristine reach of the South Fork (Kupferberg 1996).

Incidental herp sightings also have been recorded during stream surveys conducted by The Institute of Sustainable Forestry. These sightings largely have been in the creeks near Red way, Benbow, and Humboldt State Parks.

Van Duzen

A study was conducted by Pacific Southwest Research Station from 1984-1986 to determine the occurrence and abundance of the forest herpetofauna relative to forest age and moisture in 42 stands of Douglas-fir/hardwood forest in southwestern Oregon and northwestern California (Welsh and Lind 1991). Species diversity was greater in older forest stands and amphibians were significantly more abundant in older stands than in younger stands. Four study sites occurred in the Van Duzen watershed on BLM land on Butte Creek: one aquatic site in old-growth and three terrestrial sites in mature and old-growth forests. Seven species of amphibians were detected in the Van Duzen watershed during this study.

Species of amphibians known or suspected to occur in these three watersheds of the Eel River are displayed in the following Table 1.

Table 1.

AMPHIBIAN SPECIES LIST FOR SELECTED WATERSHEDS IN THE EEL RIVER BASIN

(K=species known to occur from surveys, S=species suspected to occur from range, SF=South Fork, NF=North Fork, VD=Van Duzen)

Species	SF	NF	VD	
Ambystoma gracile northwestern salamander		K	S	S
Dicamptodon tenebrosus Pacific giant salamander	K	K	K	
Rhyacotriton variegatus **southern torrent salamander**	**K**	**S**	**K**	
Taricha granulosa rough-skinned newt	K	K	S	
Taricha rivularis red-bellied newt	S			
Aneides ferreus clouded salamander	K	S	K	
Aneides flavipunctatus black salamander	K	S	S	
Aneides lugbris arboreal salamander	K	S	S	
Batrachoseps attenuatus California slender salamander	K	K	K	
Ensatina eschscholtzi ensatina		K	K	K
Plethodon elongatus **Del Norte salamander**			?	
Ascapus truei **tailed frog**		**K**	**K**	**K**
Pseudacris regilla Pacific treefrog	K	K	K	
Rana aurora aurora **northern red-legged frog**	**K**	**K**	**K**	
Rana boylii **foothill yellow-legged frog**	**K**	**K**	**K**	
Rana catesbeiana bullfrog	K	S	S	
Bufo boreas western toad	K	K	S	

2. Are sensitive species (including those listed in Table C-3 of the ROD) present or, based on best information, is there a possibility they can occur in the watershed?

Sensitive species are in bold in Table 1 and include two salamanders and three frogs. All five species are FWS Species of Concern (formerly Category 2 candidates). Del Norte salamander also is a Survey and Manage species listed in Table C-3 of the FSEIS ROD. The Eel River Basin is on the southernmost edge of the Del Norte salamander's known range with much of the Basin more than 25 miles from any known location of the species. The necessity for surveys for Del Norte salamander can be determined based on development of survey protocol and distance from the nearest known sighting (Ollivier and Welsh 1995)

3. Have intensive or extensive inventories been conducted in adjoining drainages or sub-watersheds? If so, can those inventories be extrapolated to the watershed being analyzed?

Much of the Eel Basin is in private ownership so it is likely additional surveys have been done for Timber Harvest Plans and other management activities. Additional herp surveys, other than the ones mentioned previously, were not located during this analysis.

4. Are endemic species (species limited to a small geographic area) known to occur in the geographic region of the watershed?

The Del Norte salamander is endemic to the southern-most portion of Curry County in Oregon, Del Norte County, and the northern-most portion of Humboldt County in California. The draft survey protocol (Ollivier and Welsh 1995) recommends surveying for this species within 25 miles of any known locations. Presently, the southern-most locations known for this species occurs in Township 5N, Ranges 4, 5, and 6.

5. Are exotic species known or suspected to occur in the watershed? e.g., bullfrogs or other non-native frogs or salamanders, ect.

Bullfrogs (*Rana catesbeiana*) have been introduced and occur throughout the Eel River Basin. This species is known to occur in the South Fork and Van Duzen watersheds and is suspected to occur in the North Fork. Bullfrogs were introduced into local ranch ponds for food in the 1960s. Subsequent dispersal into adjacent creeks either occurred during stock pond overflows or during drought conditions when bullfrogs traveled overland seeking other aquatic habitat.

APPENDIX C

Appendix C

Environmental and Cultural History of the Eel River Basin

By
Thomas S. Keter
Six Rivers National Forest
Eureka, CA.

Executive Summary

The purpose of this portion of the Eel River Basin Watershed Analysis is to provide an overview of the kinds and intensity of human land-use activities that have influenced the environment within three of the principal watersheds of the Basin--the North Fork of the Eel, Van Duzen, and South Fork of the Eel watersheds--during the prehistoric and historic eras. Sections are also included reviewing the limited paleoclimatic and paleoenvironmental data for the Basin, as well as a summary of the amount and intensity of archaeological investigations that have taken place, and the kinds of sites that have been recorded.

The overview has been divided into several sections. Very little data exists on the subject of the past climate and environment specifically for the Eel River Basin, nor does much prehistorical or ethnographic data exist on the aboriginal peoples who inhabited the Basin prior to the historical era. Therefore, these sections of the study are presented at the Basin level. A contextual historical overview emphasizing historical land-use patterns and activities and how these activities influenced the environment is then presented for each of the relevant watersheds. These chapters are then followed by a section summarizing the archaeological investigations that have been undertaken within the three watersheds.

Although paleoclimatic and paleoenvironmental data specifically for the Eel River Basin is lacking some research including pollen analysis studies have been undertaken in adjacent regions of northwestern California. For this reason, a more generalized and regional overview of the Holocene environment is presented for the Basin. Some research (Keter 1995) incorporating these regional studies with watershed level historical environmental studies has been under taken specifically for the North Fork Basin and is presented in Appendix 1.

Regional pollen studies and paleoclimatic research suggest that the interior regions of the North Coast Ranges have experienced significant shifts in climate during the last 10,000 years. For this reason the environment of the Eel River Basin has not remained static over time. Rather, both the species of plants found within the Basin, as well as their distribution across the landscape have varied over time. During the

mid-Holocene (8,500 B.P. to 3,000 B.P.) the mean annual temperature in interior portions of the North Coast Ranges was approximately 1.2 to 2.1 degrees centigrade warmer than today. Moreover, the dry season was somewhat longer and there was probably less annual precipitation. This period of time is referred to as the Xerothermic Period. During much of the Xerothermic Period, open oak woodlands and grasslands dominated much of the landscape within many of the interior portions of the Basin with Douglas-fir probably somewhat less widespread than today. No research to date has suggested just how this era would have affected the distribution of the redwood forests. By about 3,000 years ago the climate began to moderate with mean annual temperature averages and precipitation totals beginning to more closely resemble those of today.

With the arrival of Native Americans in the region somewhere between 5,000 and 10,000 years ago, it is likely that human land-use activities (including the use of anthropogenic [human-caused] fire, hunting and gathering activities, and the establishment of villages and camps) would have begun to influence the dynamics of the Basin's ecosystem.

Very little research in the prehistory of the Basin has been accomplished to date. Few formal archaeological investigations have been undertaken within three watersheds of the Basin that are the subject of this watershed analysis. Some excavations and archaeological investigations have occurred within the Middle Fork of the Eel River on the Mendocino National Forest and also adjacent to the Basin on the Six Rivers National Forest. In addition, excavations have taken place near Clear Lake immediately to the south of the Basin and at Pilot Ridge situated just to the north east of the Van Duzen watershed. Due to the lack of archaeological investigations within the Basin, the prehistory of the region remains to be written.

Regional studies suggest that the by about 1,100 years ago with the arrival of the Athabascans (quite possibly possessing new technologies) in northwestern California, population density within the Basin increased. During the ethnographic period (the era immediately preceding the historical era) the Basin was occupied by a number of aboriginal groups. Within the relevant watersheds, the Athabascan speaking Wailaki (including the Lassik, Pitch Wailaki, and North Fork Wailaki) occupied the North Fork watershed, the Nongatl occupied the Van Duzen watershed, and the Sinkyone and Cahto occupied the South Fork of the Eel watershed. During the ethnographic period, northwestern California was rich in game, there were large runs of salmon and steelhead trout, and plant resources including bulbs, oak acorns, seeds were plentiful. For this reason, the population density within the North Coast Ranges during the ethnographic period equaled and in some cases surpassed the population density of agricultural societies in other portions of aboriginal North America.

The southern Athabascans living within the Basin lived in semi-sedentary villages along the major stream courses. They appear to have practiced a subsistence strategy known as the "seasonal round" that involves movement throughout their home territory in order to procure subsistence resources as they become seasonally available. The more inland southern Athabascan groups probably were slightly more mobile and during the late spring and summer moved into the higher country for extended periods of time.

The historical data on the history of the Basin is fairly substantial. For this reason, there is a contextual historical overview for each of the relevant watersheds. Each is summarized below.

North Fork of the Eel River Watershed

Euro-Americans first entered the North Fork watershed in 1854. During the first decade there were numerous skirmishes between settlers and the military with the various Indian groups. This violence culminated with what has been termed "The Indian Wars of Northwestern California" between 1860 and 1865. By early 1865 most of the native peoples within the watershed had been killed in military actions, murdered, sold into slavery, or placed on Indian Reservations. With the end of the Indian "wars" more settlers began to enter the region and the livestock industry, recognizing the potential of the rich grazing lands, began to expand north into the watershed from Round Valley. Initially cattle were introduced into the region, but by about 1870 sheep dominated the rangelands of the entire region. During the period from about 1865 until nearly the turn-of-the-century, one rancher dominated the North Fork Watershed. George White controlled much of the Yolla Bolly country (southeastern Humboldt, Northeastern Mendocino, and southwestern Trinity County) from his ranch in Round Valley. White and "buckeroos," lead by Wylackie John, prevented homesteaders from settling in the watershed--often through intimidation or violence. During this era, the public record shows that somewhere between 15 and 19 murders were committed in this region in which George White and Wylackie John were somehow involved but neither was ever charged. So much violence took place in this remote area that the County Newspaper referred to all of the killings in the region as the "Long Ridge Killings."

For the next several decades, until well into the 1890s, few settlers homesteaded the region and sheep ranching was the principal land-use activity. It has been estimated that during the decade of the 1870s when the number of sheep on the ranges peaked, that at least 60,000 sheep spent at least some part of each year within the North Fork watershed. Many of the large ranches were located to the west along the main Eel River. Each summer, sheep herders would drive bands of sheep (numbering between 2,000 and 3,000 animals) slowly through the watershed on trailways leading to the high pastures of the Yolla Bolly/South Fork Mountain region.

George White began to lose his grip on the North Fork watershed after a number of setbacks including the killing of Wylackie John and the winter of 1889/90 when heavy snows decimated the livestock of the entire region. By this time there was already a trend away from sheep and back to cattle. This occurred for a number of reasons including a repeal of the wool tariff and extension of the railroad to Willits making transportation to Bay area markets more profitable.

By 1900 with George White no longer a factor in discouraging homesteading within the watershed, an increasing number of settlers began to move into the area. This movement increased after 1905 when the Trinity National Forest was created and the Forest Homestead and Indian Allotments Acts were passed by Congress. For the next decade a small community existed within the North Fork watershed including a post office (located on a local ranch), two schools, and a general store at Seven Cedars. By the Depression era many of these homesteads, accessible only by trail were abandoned.

In 1905, when the Forest Service took over administration of most of the public lands within the watershed it signaled a major shift in land-use patterns-- including increased regulation of land-use activities on public lands (for example, regulation of grazing), and forest protection (for example, fire detection and fire fighting). Over time, the Forest Service implemented an increasingly aggressive program to fight wild fires. The Roosevelt Administration greatly expanded the role of the Forest Service in actively managing public lands and this trend was further accelerated with creation of the Civilian Conservation Corps in 1932. The 1930s and 1940s saw a substantial increase in Forest Service infrastructure including the construction of fire

detection lookouts, trails, telephone networks, and resource rehabilitation work including tree planting.

In 1947 the Six Rivers National Forest was created out of portions of the Klamath, Siskiyou, and Trinity National Forests and the Mad River District (location of the North Fork watershed) was included within the boundaries of the newly created Forest. It was during this period immediately following World War II that the first significant timber harvesting on public and private lands within the watershed began. Logging on private lands peaked during the late 1950s and 1960s with numerous small mills located in the area. On National Forest lands, timber harvesting peaked in the 1970s and early 1980s. The fire history, logging history, and current social trends sections of this analysis provide additional information on land-use patterns and activities during the modern era.

Van Duzen Watershed

South Fork of the Eel River Watershed

The early history of settlement and homesteading within the South Fork watershed followed a course similar to that of the Van Duzen and North Fork. That is, the region was settled during the late 1850s and 1860s principally by homesteaders and ranchers. By the early 20th century, however, the tanbark industry, completion of the Redwood Highway, and tourism became dominant economic activities within the watershed. These activities resulted in a significant increase in population and more intensive development within the watershed than took place within the Van Duzen and North Fork watersheds. For this reason, the South Fork of the Eel River watershed has the most complex land-use history of the three watersheds covered in this Watershed Analysis.

During the period from the late 1850s to the 1870s, the portion of the watershed within southern Humboldt County (centered on the Garberville area) was known as the most remote region of Humboldt County. It was linked to the rest of the county by seasonal wagon roads. It was not until 1876 that a wagon road, the Humboldt-Mendocino Wagon Road, was constructed to link Eureka with the Bay Area (a wagon road from Garberville east to Mail Ridge connected with this road). A wagon road also connected Garberville with Briceland and continued on to Shelter Cove with a branch connecting to the north with Honeydew and Ferndale. Prior to that time the principal commercial product (wool) was transported to Shelter Cove for shipment. Finally in 1890, a more direct route, a wagon road connecting southern Humboldt County with Eureka, was constructed.

Further south, in the headwaters region of the South Fork watershed (in the Long Valley /Cahto Peak region), settlement and land-use activities during the 1800s were similar to those of southern Humboldt County. That is most of those who settled in the area maintained subsistence homesteads or became ranchers. Many of the ranches were of substantial size (numbering in the thousands of acres) and most ran sheep. A wagon road connected Long Valley with settlements to the south via Sherwood Valley. Wagon roads also led out of Laytonville to the east to Round Valley and to the west over the divide to Westport on the coast. Some local products including wool and redwood shakes, poles, and stakes were hauled by wagons to the coast for shipment to the Bay Area. Until 1876, with the completion of the Humboldt Mendocino Wagon Road, there was no road connecting the southern and more northerly portions of the watershed. For this reason, the lower

portions of the watershed in Humboldt County were oriented to the north and Eureka while the southern portions of the watershed (from about Piercy south) were oriented to the south.

It was only after the turn-of -the-century that the watershed experienced rapid growth. First, the tanbark industry provided an important economic stimulus until about 1920. Harvesting tanbark from tanoak trees (the tannin was used to tan leather) involved killing the trees by stripping them of bark. Therefore, this activity appears to have been a significant impact on the environment in areas where harvesting took place. The industry collapsed after a synthetic chemical was developed.

The reason for the accelerated population growth and intensification of land-use activities within the watershed was a result of the construction of the Redwood Highway. Due to the fact that the newly completed rail line connecting Eureka with Willits and points south occupied the best route within the Main Eel River corridor, the slightly longer route using the South Fork corridor was selected. The construction of the highway resulted in an increase in the logging of redwoods within the watershed since transportation had always been a problem. In addition, the increasing mobility of urban residents due to the automobile and the improved roads led to a significant increase in tourism and commercial development within the watershed. Another development during the early 1900s, a direct result both of the logging of redwood forests and increasing tourism was the creation of a number of state parks often in conjunction with the Save the Redwoods League.

After World War II, the demand for timber increased and for the first time, Douglas-fir became a commercially viable commodity. Timber harvesting took place at such a rapid rate that within only about 20 years nearly all of the old-growth Douglas-fir on private lands within the watershed had been logged (and most of the mills closed). By the late 1960s, the population within the watershed began to rapidly increase as urban residents began to move to the area as part of what has been termed the back-to-the-land movement. During this period, many ranches were sold and sub-divided. Finally, the illegal growing of marijuana became a major land-use activity within the basin during the 1970s. .

Environmental and Cultural History of the Eel River Basin

(South Fork Eel River Section)

By
Thomas S. Keter
Six Rivers National Forest
Eureka, CA.

Introduction

The purpose of this portion of the Eel River Basin Watershed Analysis is to provide a contextual history of the human land-use activities taking place within three of the major watersheds that comprise the Eel River Basin. The main emphasis of this study is to document how past human occupation has influenced the flora and fauna and the hydrological, erosional and depositional processes taking place within the Basin. In addition, there are brief summaries of the paleoclimatic data relevant to the basin, the status of current research in prehistorical archaeology, a synopsis of the kinds of heritage resources that have been recorded within the Basin, and the amount and intensity of archaeological survey work that has been accomplished.

The Eel Basin contains numerous micro environments---each influenced by climate, soils, geology, and other variables. Climate (including average yearly temperature, and total amount of precipitation) is especially variable within the Basin, influenced by such factors as altitude, distance inland from the Pacific Ocean, relative location on a north-south axis (there is a north to south gradient in the winter storm track), and surrounding geomorphology (for example, the rain shadow effect) that greatly affect the distribution of animals and plants across the Basin. Therefore, the environment and the prehistorical and historical settlement and land-use patterns across the Basin are far from being homogenous.

For the purposes of this study, the Eel River Basin has been subdivided by major watersheds. This overview is primarily concerned with documenting the cultural and environmental history of the following watersheds:

* North Fork of the Eel River watershed
* South Fork of the Eel River watershed
* Van Duzen River watershed

The scope of this Watershed Analysis is limited, primarily, to federal lands within the Basin. From a historical and cultural perspective, however, it is necessary to understand the interplay between environmental processes and historical and prehistorical land-use activities that have occurred across the entire landscape of the various watersheds. Therefore, a more generalized contextual overview is presented, followed by more specific data related to those areas of federal lands within each watershed that are the

primary focus of this study.

Research has been limited to a review of the literature, although some limited use of primary documents (for example, unpublished historic manuscripts, ethnographers field notes, and archaeological site records) were used when available. Subjects where data is lacking and that are in need of more research are indicated with the notion--***Data Gap***.

Chapter 1

The Climate and Environment of the Eel River Basin During the Holocene

Even prior to the arrival of humans, the environment of the Eel River Basin was in a constant state of flux. While human land-use activities have accelerated the rate of change, over the millennia, the migration of new species into the region, changes in the distribution of flora and fauna across the basin, and quite likely, the occasional out-migration or extinction of a particular species of plant or animal, all took place in response to natural processes including climate and naturally occurring fires.

The purpose of this chapter is to present a brief synopsis of the paleoclimatic and pollen data relevant to the Eel River Basin. [Summarized in Appendix 1 is a paleoclimatic model formulated for the North Fork watershed]. To date, no paleoclimatic model has been formulated specifically for the Eel River Basin. Therefore, this overview incorporates pollen data from several locations on the Six Rivers and Mendocino National Forests with regional paleoclimatic data to present a more generalized model.

Pollen Analysis in the North Coast Ranges

Several pollen studies have been undertaken in the North Coast Ranges by James West. The following overview (condensed from Appendix 1) summarizes pollen analysis data from locations on Pilot Ridge (West 1983a), Six Rivers National Forest, and at Lily Pond (West 1983b) and A-M Lake (West 1991), both of the latter located on the Mendocino National Forest. These studies are relevant because of their radiocarbon dates and time-depth, as well as their proximity of the Eel River Basin (see also West 1993). West (1983b:12-14) has hypothesized that the most important factor affecting the changing pollen counts is climate.

Pilot Ridge Pollen Data

The pollen cores were taken from a small marsh adjacent to CA-HUM-556, a prehistoric site located at an altitude of approximately 4,200 feet. There were two components to the pollen core recovered. The lower core sample dates from approximately 5,000 B.P. to around 2,600 B.P. It includes high counts for oak, with Douglas-fir counts increasing over time. Also noteworthy is the almost total lack of tanoak and chinquapin (*Castanopsis chrysopylla*) pollen until about 2,600 B.P. The upper core sample dates from about 2,600 B.P. to the present and is characterized as having high counts for Douglas-fir, pine, tanoak, and chinquapin. Douglas-fir appears to have increased in numbers during this period while oaks have decreased.

West (1983a:3.21) concludes that the currently composed Mixed Evergreen Forest on this portion of Pilot Ridge did not form until approximately 2,700 to 2,800 years ago. Prior to that time there were greater numbers of pine and oak, with fewer Douglas-fir. These changes in the pollen record reflect changes through time in both species composition and distribution of trees on Pilot Ridge; they are consistent with other

studies of the environment in the North Coast Ranges (Adam and West 1983).

Lily Pond Pollen Data

The most complete pollen core referred to in this study was that taken from Lily Pond, which is about 4 kilometers southwest of Fouts Springs in Colusa County. This area is better characterized as a marsh than as a pond; it is located at an altitude of approximately 4,000 feet above sea level. Several samples were radio-carbon dated, with the oldest registering 8,700 B.P. (± 100). The lowest portion of the core, as determined from radio-carbon dating and sedimentation rates, was estimated to be about 9,700 B.P. (West 1983b:4).

Pollen samples from pond vegetation indicate that around 7,000 B.P. the water level was lower than during the previous period (which extended to 9,700 B.P.). During the more recent past, the water level of the pond has again increased (West 1983b:10).

The pollen core data for Lily Pond suggest that prior to 8,700 B.P., this area was an open pine forest with a sparse shrub and herbaceous understory. Oak were present, but not a major part of the vegetation associations. There are high counts for TCT (*Taxaceae, Cupressaceae,* and *Taxodiaceae*) pollen, consistent with pre-Holocene sediment studies at Clear Lake. Some Douglas-fir pollen is present, but it is a very minor component. West infers that cooler conditions prevailed during this period which marks the end of the Pleistocene. Between about 8,700 B.P. and about 7,500 B.P. there appears to be a transitional period marked by warming, drier conditions during which the number of oaks increased; Lily Pond was shallower and supported dense growths of pond weeds. During this period Douglas-fir pollen count is reduced and becomes almost non-existent in the sample. The next era, dating from about 7,500 B.P. to about 3,400 B.P., oaks became a major element of the vegetation in the area. Pine counts remain high and Douglas-fir counts still remain almost non-existent, suggesting an increase or further continuation of a warmer, drier climate. Significantly, true fir (*Abies*), which were present in low amounts in the earlier levels, disappear completely from this sample. After about 3,400 B.P., major changes in vegetation distributions took place. True fir reappear, and at about the same time Douglas-fir counts begin to increase steadily until this species becomes a major component of the forest. Moreover, oak counts drop slightly, while pine counts increase slightly.

A-M Lake Pollen Data

A-M Lake is a small (approximately 1 acre) eutrophic pond between Alder and Maple Creeks on the southwestern slopes of Hammerhorn Peak at an elevation of 3,320 feet above sea level (within the upper Middle Eel watershed). The lake has no official name but was termed A-M Lake for ease of discussion in West's report (1991:1).

The age determination and sedimentation rates indicate that the bottom of the core dates to about 2,500 B.P. Pollen preservation was good, and *Pinus* was the most abundant pollen type in the sample. Douglas-fir has low counts (>1 percent) in the lower portion of the core, but these increase through time (>18 percent) in the upper samples (West 1991:4-5).

As West (1991:9) notes, "[t]he trends in the pollen record of A-M Lake are consistent with other pollen records for the region." One of his most noteworthy observations is the increase through time in the distributions and numbers of Douglas-fir at all sample locations.

Given the pollen data cited above, and other data related to climatic studies (see Taylor 1976), it appears that during the late Pleistocene and early Holocene, the climate of northwestern California was cooler than today. Evidence supporting this conclusion also includes the documentation of glaciation during this period on South and North Yolla Bolly Mountains, Anthony Peak, and other locations in the North Coast Ranges (Simons 1983:3.3).

During the mid-Holocene, lasting from about 8,500 to 3,000 years ago, the North Coast Ranges underwent a change to a warmer and possibly drier climate than that of today. This era is sometimes referred to as the as the Xerothermic Period. Dwight Simons (1983:3.13-3.14) summarizes some of the evidence for the Xerothermic Period in the North Coast Ranges (see also Barbour and Major 1977:187). This evidence includes vegetation types that are disjunct from the main areas occupied today by those species. For example, discontinuous stands of ponderosa pine extend southward from Clear Lake to as far as Mount St. Helena. Isolated stands of the Gray Pine Woodland association are found north of Weaverville, in Hoopa Valley, and in the Mad River Valley to the west of South Fork Mountain.

Some isolated stands of gray pine are also located within the North Fork watershed (see also Griffin and Critchfield 1972:Map 56). These trees are found most often at lower elevations on dry south- and west-facing slopes, especially to the east of the North Fork of the Eel River. The more continuous distributions of gray pine in the North Coast Ranges begin in Round Valley and extend southward throughout the lower elevations of the interior Coast Ranges (Griffin and Critchfield 1972:89).

Taylor (1976:307) notes that it is likely that some Great Basin plant species extended their ranges into the mountains of the North Coast Ranges during the Xerothermic Period, probably entering the area from the volcanic plateaus of northeastern California. There are several tree species found today within the Eel River Basin that are isolated from their main distributions further to the east in the Sierra and Great Basin. For example, remnant stands of western juniper (*Juniperus occidentalis*) are found in the Yolla Bolly Mountains. One isolated stand of juniper is located on Soldier Ridge in the Mendocino National Forest and is documented in the literature (Griffin and Critchfield 1972:Map 32). In addition, several other isolated stands of juniper are found within the headwaters region of the Middle Fork of the Eel River, just to the east of the North Fork Basin along Powell Ridge, in the Shell Mountain area (including an oak-juniper woodland adjacent to Mud Lake), and near Ant Point (personal observation). Furthermore, one lone tree, isolated from any other stands of juniper, was identified in the Littlefield Creek drainage of the North Fork watershed (personal observation). These trees are found at higher altitudes (above 5,000 feet), on well-drained and exposed southwest-facing serpentine soils (except for the lone tree in a glade adjacent to Littlefield Creek in the North Fork watershed) and are the locations were western juniper has been able to survive in the Coast Ranges. The closest area in which this species grows today is in Scotts Valley west of Yreka (Griffin and Critchfield 1972:21).

Further evidence for the extension of Great Basin species into the Coast Ranges includes a single grove of aspen (*Populus tremiloides*) that still survives in the vicinity of North Yolla Bolly Mountain (Griffin and Critchfield 1972:32). Also, another tree species, fox-tail pine (*Pinus balfouriana*), has disjunct populations in scattered remnant stands in the Yolla Bolly and Klamath Mountains. These trees are also found in the southern Sierra Mountains near Mount Whitney, and in portions of the upper Kings River and Kern River

drainages (Griffin and Critchfield 1972:25, and personal observation).

A General Model of Past Climate and Vegetation for the North Coast Ranges

The pollen and climatic data for the North Coast Ranges, as analyzed by West have been presented as a generalized model (West 1988:8-9; 1990, 1993). This model suggests that, during the Pleistocene and early-Holocene, the climate of the North Coast Ranges was cooler and more continental than today, with a weak subtropical high in July and strong westerly flows. During the next period, referred to as the Xerothermic and lasting from approximately 8,500 B.P. to about 3,000 to 2,500 B.P., climatic conditions changed to milder winters and warm, possibly drier, summers, probably persisting somewhat longer than those of today. Some plant species moved up-slope as much as 1,000 feet (300 meters). In addition, some species of oaks and other more xeric species migrated further to the north and west.

Beginning approximately 2,500 to 3,000 B.P., stronger maritime conditions began to prevail and the climate of the region began to change from a warmer regime to a cooler, moister one. This change, which resulted in a climate similar to that of today, has been documented in vegetation shifts in the pollen record discussed earlier. Yearly average temperatures dropped about 1.3 to 2.1 degrees centigrade, and plant species began to shift down-slope and to the south and east. Douglas-fir began to increase in numbers and distribution.

A Diachronic Paleoenvironmental Model for the Eel River Basin

A more generalized model of the past environment for the entire Eel River Basin, based primarily on the paleoenvironmental model formulated for the North Fork watershed (Appendix 1, Keter 1995) and by West (1993), is presented below.

Xerothermic Period (8,500-3,000 B.P.)

During the Xerothermic Period, yearly average temperatures were about 1.3 to 2.1 degrees centigrade warmer than today (West 1983a:3.19), resulting in somewhat warmer summers, with a longer dry season. In response to the changing climate, some plant species within the Basin migrated up slope as much as 300 meters in altitude. With longer, drier summers, the oak species currently found further to the south and to the east (in the Sacramento Valley), probably would have extended their range further northward and westward into the Eel River Basin.. The vegetation associations within the southern portions of the Eel River Basin during this era would have been similar to the more open Blue Oak/Gray Pine Vegetation Type (Küchler 1977:Map) found today in the Coast Range foothills along the western edge of the Sacramento Valley and to the south in portions of Mendocino, Napa, and Sonoma Counties. Gray pine were more abundant than today, and the oak savanna (dominated by blue oak/gray pine) and savanna vegetation

associations were major components of the environment. Oak woodlands were likely to have been more widely distributed while Douglas-fir would have been more restricted. Natural fire, and possibly toward the end of the Xerothermic Period, anthropogenic fire, would have occurred periodically, helping to maintain or encourage these vegetation associations.

At higher elevations in the Yolla Bolly region, more arid winters favored the growth of western juniper, fox-tail pine, and aspen. These tree species had wider distributions than they do today, extending north to Scotts Valley along the interior of the Coast Ranges and Klamath Mountains. It has also been hypothesized (Keter 1995) that the some of the fauna of the Basin would have been affected by the changes during the Xerothermic Period. For example, within the North Fork of the Eel River watershed, because vegetation moved up slope approximately 1,000 feet in response to warmer temperatures during the Xerothermic Period, the summer deer range was probably also somewhat higher in altitude than today. This rise in altitude would have reduced significantly the amount of habitat in this region available for summer range (today's summer range in this area is above 4,000 feet). Within the North Fork watershed and the region immediately to the east, many of the peaks and ridge lines (including Jones Ridge, Mad River Ridge, and Haman Ridge) are between 3,500 and 4,000 feet. The reduction in summer habitat and concentration of deer at higher altitudes (probably in areas above 4,500 feet) may help to explain the presence of so many Early Period sites at higher altitudes in this region--for example, Government Flat, Estle Ridge, Soldier Ridge, and South Fork Mountain.

The Xerothermic Period would also have affected the anadromous fish populations. Because of the warmer, longer, and drier summers (and in all probability diminished yearly rainfall and snowpack) during the Xerothermic Period, stream flows would have been reduced within the Basin. The density and distribution of the riparian vegetation would probably have also been reduced. In view of the critical need for cold water temperatures and adequate water flows to maintain critical summer habitat, it is likely that there was a significant reduction in the number of anadromous fish within some of the more marginal water courses of the Basin (for example, the North Fork watershed and possibly upper portions of the main stem further to the south). The number of perennial springs in the region would probably also have been reduced, influencing both the distribution of deer and other species of wildlife and the selection of locations by the region's aboriginal inhabitants for temporary seasonal camps and villages.

It is not known just how a change in climate would have effected the distribution of the redwood/tanoak vegetation communities within the basin. Studies further to the west on the high ridgeline dividing the South Fork of the Eel River watershed from the coast near Usal have identified a number of what appear to be Early Period village sites (Peak and Noble 1983). It appears that when these villages were inhabited the dense redwood forest in this region was at least broken along the ridgelines by some prairies. This may have been the result of either climate or anthropogenic fire.

Post Xerothermic Period (3,000-2,500 B.P. to 1865)

By about 3,000 to 2,500 years ago, the distribution of plant species within the Basin began responding to the increasingly more maritime weather pattern. Inland, in what is now the Bald Hills region of the Basin, white oak and Douglas-fir began to move down slope and spread across the lower elevations as the more xeric species of oaks retreated to the south and east. It is likely that grasses, forbs, bulbous plants, and other plant species also responded to changes in both climate and distribution of tree species.

It appears (Keter 1995) that an extended period (measured in centuries) was needed for vegetation associations to respond to the changing climatic conditions (due to what might be termed "vegetative inertia" the tendency for a biotic community to resist change). Natural fire also played a role in slowing the rate of change taking place within plant communities in response to the moderating climate. Sometime during this era, aboriginal land-use activities (including anthropogenic fire and resource procurement) became major factors influencing the environmental dynamics of the region.

With a more maritime climatic pattern influencing the region, stream flows during the dry season increased. Moderating climatic conditions (shorter dry season, reduced evapotranspiration, possibly increased precipitation) also provided for increases in groundwater flows and the number of live springs in the Basin. At lower altitudes, along the stream courses of the region, habitat improved for anadromous fish species, and the availability of this resource probably increased over time. These changes in the environment, and the resulting increase in the availability of subsistence resources, would have made this area more attractive for permanent habitation by humans.

Within the South Fork of the Eel River watershed, it is likely that changes occurred in the extent and distribution of the redwood/tanoak forest region. More research is needed to document these changes, however, some of these changes may be reflected in site settlement patterning in the prehistoric record (for example, see Peak and Noble 1983).

Data Gap:

To better understand the dynamics of the past environment of the redwood forest region of the Basin, it is suggested that pollen analysis studies should be undertaken within the western portions of the Basin that lie within the redwood/tanoak belt.

Chapter 2

Prehistory

It has only been within about the last two decades that any significant amount of archaeological research has been conducted within the North Coast Ranges. Much of this work has been accomplished on public lands as a result of the federal laws and regulations related to cultural resources. Archaeological excavation and survey work on the Six Rivers National Forest, Mendocino National Forest, and on Bureau of Land Management lands in the King Range Conservation, area have all contributed significantly in increasing our understanding of the prehistory of northwestern California. However, within much of the Eel River Basin (except those portions within Six Rivers and Mendocino National Forests), little in the way of archaeological work has occurred (this is especially true for the Van Duzen and South Fork of the Eel watersheds). Therefore, much of the prehistory of the Eel River Basin remains to be written. To date, archaeologists in the North Coast Ranges have been concerned primarily with formulating a chronology for the region explaining when humans first entered this region, in developing an understanding of resource procurement strategies, and where human settlements were likely to have been located across the landscape.

Given the lack of research and the limited prehistoric data, the following overview for all three relevant watersheds is presented at the Basin level.

North Coast Ranges Chronology

The Eel River Basin extends north from the Russian River divide to Humboldt Bay. At this time, it is not clear when humans first entered and settled within the Eel River Basin. For purposes of this overview, two chronologies are applicable---the first was developed for the region just to the south of the Eel River Basin around Clear Lake and the second for the inland higher altitude regions of the northern portion North Coast Ranges including the North Fork and upper Van Duzen River watersheds. Although no chronology has yet been formulated specifically for the Basin, it is likely that prehistory of the Basin lies somewhere within these two chronologies.

Chronology of the Clear Lake Region (Southern North Coast Ranges)

Studies to the south of the Eel River Basin near Clear Lake have placed the earliest occupation of that region at about 10,000 years ago (possibly as early as 12,000 B.P.). The following is a brief summary (see also Fredrickson 1984:497-498) of the current chronology for the southern North Coast Ranges.

Paleoindian Period (ca 12,000 B.P.-8000 B.P.)

This period, represented by the Post Pattern is believe to represent the earliest occupation of the North Coast Ranges. Artifacts characteristic of this period include fluted projectile points and chipped stone crescents.

Lower Archaic Period (8,000 B.P. to 5,000 B.P.)

Represented by the Early Borax Lake Pattern, artifacts from this period include Borax Lake Wide Stem points, manos, and metates (the latter two are stone implements used for processing acorns, seeds, and other plant resources).

Middle Archaic Period (5,000 B.P. to 3,000 B.P.)

This period is represented by the Borax Lake Pattern. Artifacts characteristic of this period include non-fluted concave base projectile points, large leaf shaped contracting stem projectile points, and ground stone artifacts (including bowl mortars, metates, and pestles).

Upper Archaic Period (3,000 B.P. to 1,500 B.P.)

Artifacts from this period are characterized by contracting stem and lanceolate points, motars, pestles, manos, and , metates.

Emergent Period (1,500 B.P. to beginning of the Historic Period [c1850])

This period is represented by small corner notched , side notched, barbed points (possibly signaling the introduction of the bow and arrow into the region)

Northern North Coast Ranges Chronology

Immediately to the north and east of the Van Duzen watershed, excavations were conducted at a number of sites along Pilot Ridge and South Fork Mountain on Six Rivers National Forest during the mid-1980s by Sonoma State University (Hildebrandt and Hayes 1983, 1984; Hayes and Hildebrandt 1985). This work resulted in the formulation of a chronology for the inland, high altitude areas of the northern North Coast Ranges. This chronology also incorporated paleoenvironmental data and a catchment analysis by Dwight Simons that permitted the investigators to integrate chronology with paleoenvironmental data. It is likely that this chronology is especially relevant for the interior regions of the Basin, including the upper Van Duzen, North Fork, and Middle Eel watersheds.

Researchers have found three broad cultural patterns for this portion of the North Coast Ranges. The definitions of these cultural patterns are based on chronology and artifact patterning. These time periods,

and their primary characteristics, are summarized below.

Early Period (5,000-4,500 BP. to 2,800 B.P.)

The earliest period of human occupation in the northern portions of the North Coast Ranges is also sometimes referred to as the Borax Lake Tradition. It spans that period of time from the entry of aboriginal peoples into the region, approximately 4,000 to 5,000 B.P. to about 3,000 B.P.--roughly coincidental with the change in the region's climate at the end of the Xerothermic Period. Little is known about the first people to enter this portion of the North Coast Ranges, neither the language they spoke nor where they came from. The artifacts found on prehistoric sites within and adjacent to the region dating to this period include the Borax Lake Pattern assemblage defined by large Borax-Lake wide-stemmed projectile points, milling slabs, hand stones, relatively large serrated bifaces (worked on both sides with a saw-like edge on some portion of the artifact), and edge flaked spalls.

Several "single component" Borax Lake assemblages (i.e. all the materials recovered from a specific area of the prehistoric site dated from this time period) were identified. These assemblages show little variability from site to site (Hildebrandt and Hayes 1993:110) and for the most part appear to be locations where a number of subsistence oriented activities (processing of both animal and plant resources) took place--inferring that family groups were camped at these locations. Further support for this hypothesis is the recovery from the Borax Lake components of these sites of a greater percentage of artifacts associated with food processing and household maintenance activities than were recovered from either Middle or Late Period single component sites. Early Period artifactual materials included handstones, spall tools, cobble tools, and drills.

One of the sites excavated on Pilot Ridge (Hildebrandt and Hayes 1983) contained a feature which appears to be the remains of a structure approximately 5 foot by 5 foot in size. Structural indicators included a possible compacted floor surrounded by three post holes (Hildebrandt and Hayes 1993:110). This feature contained a significant number of artifacts, including 12 milling slabs (two of which were stacked one on the other), four hand stones, three hammer stones and numerous bifaces, projectile points, flaked tools and cores. This feature represents the oldest structural remains to be found to date in this region of the North Coast Ranges.

It has been hypothesized that the people living in this region during the Early Period lived in small, highly mobile bands, probably consisting of one or a small number of extended families. These small groups utilized a "foraging" resource procurement strategy oriented towards a wide range of resources, but emphasizing little handling or processing time such as big game (elk and deer) and hard seeds. With this resource procurement strategy, little emphasis is placed on storage of food resources, rather "incongruities in the distribution of resources over time and space are solved by moving people from places of declining productivity to areas where foraging opportunities are enhanced" (Hildebrandt and Hayes 1993:115). Thus, within the Eel River Basin and adjacent areas (for example Pilot Ridge and further south Soldier Ridge) during the Early Period, it is likely that relatively small, highly mobile groups inhabited the region for at least some portion of the year, moving from location to location as various kinds of resources became seasonally available for

procurement. This subsistence strategy requires frequent moves by entire social units resulting in homogenous settlement site structure (ie. little site-to-site variability) with similar generalized artifact assemblages (Hildebrandt and Hayes 1993:115).

Even at this early date, land-use activities related to subsistence resource procurement were, quite likely, having an effect on the environment. By this time, anthropogenic (human caused) fires, along with natural fires, were quite likely major forces influencing vegetation trajectories and environmental dynamics in this region. In addition, collection of certain plant species and the hunting of animals also influenced environmental dynamics and trajectories. For example, the large Borax Lake projectile points were probably used on spear points or atlatl darts for the hunting of large game animals, including elk. It has been hypothesized that the over-hunting of elk and the resulting reduction in their numbers may have influenced the shift to the utilization of a wider range of resources including acorns.

Middle Period (2,800 B.P.-1,100 B.P.)

The Middle Period spans that interval of time between approximately 3,000 B.P. and 1500 B.P. The beginning of this period is roughly coincidental with the change in climate at the end of the Xerothermic Period. This change in climate has implications for the prehistoric record. It appears that montane forest began to increasingly dominate at higher elevations (above about 4,500 feet in the northern portions and 4,000 feet in southern portions of the basin). This change in vegetation distributions through time resulted in a shift in resource procurement strategies. The artifact assemblages recovered from single component site areas dating from this period include Willits Series, Mendocino Corner-notched and McKee projectile points, bifaces, flake tools, and mortars and pestles.

During this period, there appears to have been a decline in the intensity of use of the upland region. This decline is reflected in the archaeological record with a reduction in the relative amount of Middle Period artifactual materials recovered from the high elevation sites when compared to the number of artifacts recovered from the Early Period.

Archaeological evidence suggests that it was during this time period, that the shift from a forager to a "collector" based subsistence strategy began to take place. Collectors store foods for some part of the year; usually in sedentary or semi-sedentary villages. In addition, rather than a need for group mobility, as in the forager resource procurement model, distributions of resources across time and space are solved by moving the resources to consumers, resulting in fewer residential moves. Land-use activities in relation to settlement patterns are, therefore, also changed. Under the collector strategy, intersite variability becomes more pronounced. There are, for example, residential sites (villages) as well as various other kinds of specialized sites used for the collection of specific resources. These resources (such as acorns, grass seeds, or deer) were gathered and/or processed at special use sites, then transported back to the main village locations (Simons 1983:1.23).

In addition to changes in climate and vegetation species trajectories, another factor which

might have influenced both site settlement patterns was the increase in population density. Population growth necessitates that more energy be extracted per unit of land. Generally this is accomplished by an increase in the range of resources utilized. That is, there is an increased use of lower ranked resources.

Given the intensification in the procurement of subsistence resources resulting from an increase in population density, the procurement of a wider range of resources, and the use of fire to promote the productivity of desired resources, it is probable that by the end of this period the environment of the region was being affected to some extent by human land-use activities. Over time, this dynamic between a more intensive use of natural resources and an ever-increasing human population could have been a significant factor influencing the evolution of the region's ecosystem.

Late Period (After 1,100 B.P.)

This period extends from approximately 1,500 B.P. to the beginning of the historic era (often referred to as the Contact Period) and includes the ethnographic period (which will be discussed in greater detail in the next section). The artifact assemblages recovered from these sites were predominantly of flaked stone tools (ie. projectile points, cores, bifaces and other flaked tools [Hildebrandt and Hayes 1993:112]) similar to artifact assemblages found in Middle Period components. Artifacts characteristic of this period include Trinity corner-notched, Trinity diamond-shaped, and Gunther series projectile points and milling equipment including the hopper mortar and pestle.

It appears that there was a continuing increase in population density and an intensification in the collection of lowland subsistence resources like fish and acorns. There was also more emphasis placed on the storage of resources for winter consumption. Sites located away from the sedentary village locations along the rivers are of a more limited and specialized nature reflecting their use as temporary camps visited for specialized resource procurement activities (Simon 1983:1.26).

By the Late Period, aboriginal peoples, through their land-use activities and increased population density, were an important influence on the environmental dynamics of the North Fork watershed. Human land-use activities, by this time, were significant factors influencing the mix of plant species and animal species found in the region. The next section discusses in greater detail the effects of human land-use activities within the Basin during the ethnographic period.

In this region, a theoretical dispute among archaeologists exists concerning the relationship between the peoples occupying the area towards the end of the Late Period (ie., the ethnographic period) and those living here during the Early and Middle Periods. One hypothesis suggests that the changing adaptations to the environment and the ethnographic cultural patterns present at the time of historic contact occurred in place and were relatively early in origin. The alternative hypothesis (Hildebrandt and Hayes 1993:116), also supported by linguistic data (Whistler 1979), contends that many of the adaptations related

to the exploitation of subsistence resources and cultural patterns present during the ethnographic period were brought in by immigrant groups with "technological systems preadapted to the local resource base".

This second theory suggests that the original inhabitants, of at least the inland portions of much of the Eel River Basin in the Van Duzen Watershed, were ancestral Karuk (Hokan Stock) with a culture focused on an inland-oriented subsistence resource procurement strategy. The evolution of both inland and coastal cultures during the later portion of the Late Period is summarized by Hayes and Hildebrandt (1993:116).

Around 1,100 B.P., the Wiyot arrived and occupied previously under-populated and under-exploited coastal habitats. Soon thereafter, the Yurok settled along the lower Klamath and adjacent coastline, a process made possible by their superior technological abilities to fish, build boats, and store salmon. Marking the beginning of the Gunther Pattern, these arrivals are thought to be manifested archaeologically at a series of coastal sites containing Dentalium shells, bone and antler harpoon points, various woodworking tools, ceremonial obsidian bifaces, and ground stone zoomorphs, as well as a variety of other artifact forms.

The final wave of immigration were Athabascan speakers (the ethnographic Tolowa, Chilula, Hupa, Whilkut and southern Athabascans). Arriving about 700 B.P. and occupying areas peripheral to the Wiyot and Yurok, these groups possessed an acute knowledge of forest and riverine environment, and possibly an improved technological system that included the toggle harpoon and sinew-backed bow.

Prehistory of the Eel River Basin

Archaeological investigations within the Eel River Basin have taken place for the most part on sites located within the Mendocino National Forest on the upper portions of the Middle Fork of the Eel River and its tributaries (see for example, Edwards 1966, King 1966, King 1974, Jackson 1976, Holson and Fredrickson 1980, Holson 1986, Eidsness 1986, Waechter and Origer 1992, Huberland 1993). Given the large amount of territory encompassed by the Eel River Basin, however, it is likely that these studies have only limited applicability to the remainder of the Eel River Basin. For example, no formal excavations have been undertaken farther to the north within the Van Duzen watershed, or to the west within South Fork of the Eel watershed---both of which are vastly different in environmental variables and climate.

In broad terms, and based on the two closely related chronologies presented in the last section, it is likely that humans first entered the Eel River Basin at least 5,000 years ago and that human land-use activities have influenced, to some degree, the ecosystem of the Eel River Basin for thousands of years. One possible hypothesis for the evolution from a forager- to a collector-based economy within the Eel River Basin is that, prior to about 1,100 A.D., the more southerly portion of the Basin was inhabited by the Yuki (or proto-Yuki) while the more northerly portions of the Basin were inhabited by Hokan speakers (proto-Karuk). This hypothesis is based on linguistic evidence (Whistler 1979), the proximity of the Yukian peoples directly to

the south, and evidence related to the early arrival of Hokan speakers in the northern portion of Humboldt County. The linguistic evidence also suggests that these two groups pre-date Athabascan movement into the region (those aboriginal groups inhabiting the region during the ethnographic period). It is also possible that Penutian speakers (Wintu or proto-Wintu) from the east may have also utilized portions of the Basin during this era. Perhaps the arrival of Athabascan speakers was roughly contemporaneous with, or could only have occurred sometime after the region became more productive as a result of the changing climate. The more intensified and diversified utilization of natural resources led to an increase in population and further specialization in the procurement of localized resources.

Data Gap:

Further archaeological investigations will be necessary to adequately document the prehistory of the Eel River Basin. This is especially true of the Van Duzen and South Fork of the Eel River watersheds,

Chapter 3

Ethnography

The Eel River Basin has been traditionally viewed by anthropologists as a culturally and linguistically complex region and as a transition zone between the California Culture Area that encompasses much of the state south of the Basin and the Northwest Coast Culture Area which extends from about Humboldt Bay north along the Oregon and Washington coast into southern British Columbia. Thus, many of the groups living in this region are viewed by anthropologists as having cultural traits and subsistence and resource procurement strategies that have been influenced to some degree by groups residing to the north and to the south of the Basin.

During the ethnographic period, the Eel River Basin was inhabited by a number of linguistically and culturally diverse groups. To the north along the lower reachers of the river, the Wiyot (classified linguistically as Algonquin speakers) occupied much of the Eel River Valley from the mouth to somewhere south of the confluence of the Van Duzen. Much of the interior portion of the Van Duzen watershed, the South Fork watershed, and the North Fork of the Eel watershed were inhabited by several closely related Athabascan groups; while further south in the upper Middle Eel and the upper Main Eel watersheds were occupied by the Yuki, Huchnom (Yukian language Stock) and Pomo (Hoakan language Stock).

More specifically, those groups most directly associated with the portions of the Eel River Basin discussed in this overview are presented below.

North Fork of the Eel watershed--Wailaki (Pitch Wailaki, North Fork Wailaki, Lassik)
Van Duzen watershed-- Nongatl
South Fork of the Eel watershed--Sinkyone, Cahto,

The proceeding section provides a brief overview of these groups focusing on delineating their location with each of the relevant watersheds within the Basin, as well as the primary settlement and subsistence strategy orientations of the various groups.

The Athabascan speaking peoples of northwestern California can be broadly divided into three distinct subgroups. The most northerly group were the Tolowa. Their territory centered on the coastal plain which fronts the high mountains and deep canyons of the Smith River drainage near the California/Oregon border. Further to the south, the Hupa, and the closely related Chilula and Whilkut, occupied much of northeastern Humboldt County along the Trinity River, as well as portions of the North Fork of the Mad River and Redwood Creek watersheds.

The most southerly group of the Athabascan speakers in California occupied the central and southern portions of Humboldt County, northern Mendocino County, and southwestern Trinity County. They have been referred to in the ethnographical literature as the southern Athabascans. They are the southernmost extension of Athabascan speakers along the Pacific coast.

The major groupings have been delineated as the closely related Wailaki, Pitch Wailaki, North Fork Wailaki, Lassik, the neighboring Sinkyone, and the Nongatl. In addition, the Cahto, the southernmost-Athabascan

group on the Pacific Coast (Myers Vol 8:244) inhabited the region around Long Valley and Branscomb but appear, culturally, to have had more in common with the Yuki and Northern Pomo.

For purposes of this overview the southern Athabascans have been divided into two distinct subgroups based on the similarity of their cultures and the similar environments of their respective territories that appear to have produced similar subsistence procurement strategies and land-use activities.

Inland Southern Athabascans

The Wailaki, North Fork Wailaki, Pitch Wailaki, Lassik, and Nongatl occupied the more inland regions of the Basin, including much of the Van Duzen watershed, all of the North Fork of the Eel watershed, and the main stem of the Eel River below about Outlet Creek. This region has been referred to as the "Bald Hills." It consists of a northwest to southeast trending swath of oak woodlands and savanna in the North Coast Ranges lying between the redwood-tanoak belt to the west influenced by the Pacific Ocean and the higher altitude distributions of montane forest to the east. The Bald Hills stretches south from about Pilot Ridge to Round Valley.

Coastal Southern Athabascans

The Sinkyone occupied the region immediately adjacent to the coast and the redwood belt that includes the South Fork of the Eel River watershed. The subsistence strategies in this region of the basin were oriented more towards anadromous fish and coastal resources (including marine mammals), with some upland use but not as much as for the inland groups. Redwood forest tended to dominate much of the lower river and stream channels.

It is likely that the Cahto, inhabiting the region immediately to the south of the Sinkyone in the headwaters region of the South Fork Eel watershed, pursued a similar subsistence procurement strategy. It appears the Cahto, however, had much more in common with their neighbors to the south that with other southern Athabascan groups.

The South Fork of the Eel: The Coastal Southern Athabascans

The coastal southern Athabascans were closely related linguistically and culturally to the Wailaki. The main difference was that their territory was influenced to a greater degree by maritime conditions and there was a wider distribution of conifers (especially redwood forests). In addition, many of these communities had direct access to maritime resources including fish and marine mammals. The following groups occupied portions of the South Fork watershed during the ethnographic period:

Sinkyone

The Sinkyone were closely related culturally and linguistically with the Wailaki. It appears, however, that riverine resources were somehwhat more abundant within the territory of the Sinkyone when compared to the inland southern Athabascan groups. Elsasser (1979:193) notes that among these closely related groups,

> only the Mattole and Sinkyone appear to follow the pattern of the lower Klamath River peoples like the Yurok and Karok in exploiting fish as a primary resource, more than game and acorns.

In addition, some Sinkyone communities had direct access to marine resources.

Due to linguistic differences, some of the early ethnographers (for example Merriam and Kroeber, c.f. Baumhoff 1958:184), further subdivided the Sinkyone into two groups--the Lolangkok and the Shelter Cove Sinkyone. The Lolangkok occupied the portions of the main Eel south from Shively on the east side of the river to about Dyerville and all of the South Fork of the Eel watershed south to almost Phillipsville. The Shelter Cove Sinkyone occupied a portion of the South Fork watershed south from Phillipsville to Cahto territory in the headwaters region of the South Fork as well as a portion of the coast south from Matole territory to about the mouth of Usal Creek.

Early 20th century ethnographers (see Baumhoff 1958 for a review of the ethnogeographic data) recorded numerous village sites along the South Fork and its main tributaries (including Bull, Salmon and Redwood Creeks). Martin Baumhoff (1963:173) indicated that of the southern Athabascan groups only the Sinkyone and Nongatl (those communities along the lower Van Duzen) had a "primary" part of the Eel River within their territory. Given this greater focus on riverine resources and the fact that much of their territory was within the redwood belt, it is likely that the Sinkyone followed somewhat less of a seasonal round traveling through the mountainous country of their territory during the summer than did the Wailaki. In addition some of the Shelter Sinkyone communities (and quite possibly Lolangkok communities with kinship ties to the Shelter Cove Sinkyone) had access to the coast and the associated subsistence resources (including large marine mammals).

Cahto

The Cahto were the southernmost Athabascan speaking tribe along the Pacific coast. They occupied the upper reaches of the South Fork of the Eel River watershed. Most of their village sites were located in Long, Cahto, and Jackson Valleys. Historically, they have been recognized as somewhat apart culturally and lingustically from the other southern Athabascan groups. Given their location adjacent to Yuki territory and only a short distance from northern Pomo territory, they appear to have been much more influenced by their southern neighbors than the other Athabascan groups. Ethnographers noted that in many Cahto villages, Pomo was spoken as a second language (Myers 1979:244). In addition, the Cahto share many religious and cultural affinities with the Northern Pomo and Yuki. As with the other southern Athabascan groups, however, there is a lack of ethnographic data.

Much of the region inhabited by the Cahto contains heavy timber, including dense redwood forests. Given this fact and the lack of ethnographic data, it is not clear to what extent the upland regions were used. It

appears that most of the villages, however, were located along the river and creeks in Long, Branscomb, and Cahto Valleys.

Coastal Southern Athabascans
Seasonal Round

It is likely that the coastal groups followed a subsistence strategy similar to that of the inland groups. [Refer to the ethnographic section of the North Fork watershed overview for a summary of the seasonal round]. It appears, however, that the Sinkyone relied somewhat more on anadromous fish that the inland southern Athabascans. Another main difference was that many of the Sinkyone communities spent at least some portion of each year at the coast. Also, given the lower altitude of the mountains adjacent to the South Fork of the Eel River region as compared with the interior Coast Ranges, it seems likely that more time was spent in their villages with occasional trips to the mountains for specific resources.

Data Gap:

More data is needed to formulate a seasonal subsistence model for the coastal Souther Athabascans. This model should highlight the principle subsistence resources collected, the time of year, and how these land-use activites would have influenced the dynamics of the local ecosystem.

Chapter 4

The Historic Period: The North Fork of the Eel River Watershed

This purpose of this chapter is to present a brief overview of the historical development of the North Fork of the Eel watershed. The historic era has been divided into four periods, with each defined by the socio-economic themes and land-use activities that dominated the period.

1854-1865	Conflict and Settlement
1865-1905	Ranching Period
1905-1947	Homestead Period
1947-	Modern era

Chapter 5

The Historic Period: The Van Duzen River Watershed

Chapter 6

Historic Period:
The South Fork of the Eel River Watershed

While the upper reaches of the Van Duzen River and the North Fork of the Eel River watersheds have many similarities in the kinds of historical land-use activities that took place, the South Fork of the Eel River has a much more diverse land-use history. The former watersheds contained extensive oak woodlands and grasslands that were prime ranching country. Over the years, economic development of these watersheds was related primarily to ranching and the settlement of small subsistence-oriented homesteads and more recently timber harvesting on both private and public lands. The South Fork of the Eel watershed has a much wider range of vegetation associations including not only grasslands and oak woodlands, but also significant distributions of redwood and Douglas-fir /tanoak forests. In addition, very little of the watershed remains within public ownership. For these reasons, the South Fork watershed has an extremely complex and varied land-use history.

The South Fork Eel Watershed can be divided roughly into four segments defined by vegetation and topography. Each of these segments has a relatively unique combination of resources that, at various times, given socio-economic conditions of the particular period, have provided a stimulus to economic development. The lower South Fork Eel River region, extending from its confluence with the Main Eel River to about Myers Flat, is dominated by a dense redwood forest. Some of the higher elevation hillsides on more southerly oriented slopes contain some grasslands, oak woodlands, and Douglas-fir/tanoak forests. Within the second segment, from about Myers Flat to just south of Piercy, the distribution of vegetation associations becomes much more diverse. While many of the river terraces and lower reaches of side drainages (to the west of the river) are dominated by redwood, there are also large areas of grasslands and oak woodlands reaching down to the river on a number of south and west facing slopes (for example Bear Buttes, Red Mountain, and Pratt Mountain). This region is inland from the Mendocino Peninsula and therefore receives somewhat of a rain shadow effect (while the fog, important for redwoods, tends to flow up the Eel River Valley from the coast). In this area, ranching was the first important industry. In the 20th century, however, the economy of this portion of the river has become more diverse with logging, the tanbark industry, and tourism becoming important economically.

The third segment extends from about 1 mile south of Piercy to near Cahto Peak. Here the river cuts a deep canyon through the Coast Range Mountains, the hillsides are heavily timbered (especailly to the west of the river) and there are few locations (Leggett Valley for example) for settlement. This portion of the watershed is only a few miles from the coast (where the southern end of the Mendocino Peninsula cuts back to the east), and is more influenced by maritime conditions than the preceding segment. For this reason, there is a much more dense distribution of Redwood at lower elevations with Douglas-fir/tanoak dominating on many of the upper slopes (especially on north facing slopes). The fourth segment, the upper headwaters region (south of about Cahto Peak), is dominated by Cahto and Long Valleys. In this region, portions of the watershed to the west are predominately redwood and Douglas-fir/ tanoak forests, while those areas to the east of Cahto Peak and Branscomb are dominated by oak woodlands and grasslands. Douglas-fir and Ponderosa pine are also common in this area.. Also of note, Ten Mile Valley (located directly to the north of Long Valley) is the most northerly distribution of the Valley oak (*Quercus lobata*)(Griffin and Critchfield 1972:36).

1850-1865 Exploration and Early Settlement

The first documented exploration of the South Fork watershed during the historic era was by members of the Josiah Greg Party in late 1849 and early January of 1850. They had left the Trinity mines in November and headed west hoping to discover a land route from the coast to the mines. After "discovering" Humboldt Bay, the party headed south. An argument among the men (concerning the return route to the settlements in Sonoma County) broke out near the mouth of Van Duzen River. One group of men led by L.K. Wood headed up the Eel River, while Greg and the rest of the party headed west in an attempt to reach Sonoma via the coast. The Greg Party was finally forced inland due to the rough coastline. Both parties passed through the South Fork watershed and after numerous hardships finally made it to the Sonoma settlements. In Lake County, Greg died when "he fell from his horse...and died from starvation" (Coy 1929:43) (others suggest a more sinister plot involving his murder since he had become intensely unpopular with the rest of the men during the journey).

In 1851, the Redick Mckee expedition, whose purpose was to make treaties with the Indian tribes of the region (these treaties were never ratified by Congress), was lead by Thomas Sebring, a member of the Greg Party. They followed the route blazed the year before and this route became the main overland trail linking Humboldt Bay with Sonoma County. The trail passed through Little Lake Valley and then into Long Valley. North of there, it headed along the divide between the South Fork and Main Eel (roughly following the Bell Springs Road). The trail continued north past Harris (Spruce Grove) and then dropped down to the west to about the present location of Garberville, following the South Fork of the Eel north to its confluence with the main Eel. Later, a new route was blazed that dropped down from Harris to the east to Alderpoint on the main Eel. From here, the trail continued north to Bridgeville and Kneeland before dropping down to Humboldt Bay. By 1859, a wagon road connected Long Valley with the settlements to the south.

Another early explorer who passed through the South Fork watershed was Ben Kelsey (a leader of the Bear Flag Revolt). Some early maps have "Kelsey's River" as the name for the South Fork of the Eel.

As noted in the earlier histories of the Van Duzen and North Fork watersheds, the era from 1855 to 1865 was a period of conflict between the Indians and the new settlers. This conflict, actually a series of clashes between the Army and settlers with the various Indian groups in the region, has been termed (collectively) by Bledsoe (1885) as the "Indian Wars of the Northwest." During this period, nearly all of the Indians within the South Fork watershed were displaced from their homelands. Many were killed and the survivors were placed on the Round Valley Indian Reservation. In addition, Long Valley became a center for the selling of Indian children to wealthy families in the Bay Area under the Indenture Act of 1850. Captain Thomas Ketcham, while commanding a company of troops stationed at Fort Baker, reported (USWD 1897a:982):

> I have been informed that there are quite a number of citizens who intend as soon as the snow goes off, to make a business of killing bucks whenever they can find them and selling the women and children into slavery. It is supposed that they will make their headquarters somewhere in the neighborhood of Fort Seward, taking their captives to Long Valley, there selling them to certain parties for $37.50 per head, who put them in a covered wagon, to take them down to the settlements, and there dispose of them at very handsome profit.

Within the South Fork of the Eel watershed there were numerous conflicts between the settlers and the Indians. For example, a number of homesteaders had settled in the vicinity or the present town of

Garberville. In early 1861, Indians attacked one of the homesteads in the area owned by the Sproul brothers. The Indians were driven off but both brothers were seriously wounded. This incident was followed by an attack on a Sinkyone village near the present location of Briceland where many Indians were killed and the rest driven off.

The conflict between settlers and the Indians continued until early in 1865. By that time the army had rounded up the survivors and placed them on reservations at Round Valley or Hupa. With this action, the last impediment to settlement was removed and the number of settlers entering the region began to accelerate.

Early Settlement

Mendocino County

Within this portion of the watershed the principal locations for early historic settlement were in Long Valley and some of the smaller valleys near the head of the watershed (Cahto, Ten Mile and Branscomb Valleys). The first to settle in this area were Robert White and James Simpson. In 1856 they settled in Cahto Valley. There was a small swampy lake at this location and the men lowered the level of the outflow and drained out the water. Over the years this outflow has developed into a deep gorge. Within a short time, a number of other settlers had moved into the area (Mayo 1974:2). By 1860 there were quite a few settlers, some with families, living in the Cahto/Long Valley area. In 1861, Simpson built a hotel in Cahto. It was on the route from the inland ranches to the coast at Westport.

By 1865 conflicts between the new settlers and the Cahto had ended with most of the surviving Indians being placed on reservations. In addition, there was a rancheria in Cahto. The following information was found in the folder on Cahto and Laytonville at the Historical Society in Ukiah, and is worth quoting at some length.

> Merchandise was freighted in [to Cahto] on the backs of Indians, from the seaport town of Westport. Each Indian was given approximately 80 pounds to carry.
>
> They were rewarded for making the trip with a cheap handkerchief, or a shirt or some other article of clothing.
>
> They were given but little consideration and would be stripped to the waist lashed after the manner of punishment inflicted on the Negro of the south during the days of slavery.
>
> John Simpson, an army captain, was placed in charge of the Indians by the Government, and he held them in subjection with an iron hand.

It appears that the number of Indians Simpson controlled numbered about 75.

In 1865, Simpson and White built a saw mill with a capacity of about 2,000 board feet per day in Branscomb.

In 1870, the Cahto School district was established and in 1880 there were about 53 students.

During the last half of the 19th century numerous subsistence homesteads were established in the region--especially from about the confluence of Ten Mile Creek south to Branscomb Valley and in the regions to the east of Branscomb including Cahto and Long Valley.

Humboldt County

The Garberville area was first settled in 1862 by J.E. Wood and there were other several homesteaders (including the Sproul brothers as noted earlier) living in the vicinity. Due to conflicts with the Wailaki and Sinkyone, few settlers homesteaded in this area until 1865.

Ranching and Homesteading 1865-1900

It was during this period that nearly all of the public domain lands within the watershed were conveyed into private ownership. Because the watershed is so large this portion of the study has be divided into several sections. The first part of this section covers the history of that portion of the South Fork Eel River watershed within Mendocino County and the second covers those portions of the Watershed within southern Humboldt County. Also included are thematic sections on transportation and mining.

Mendocino County: Settlement and Homesteading

During this era, poor transportation infrastructure limited development of the region. There was also a "break" or division at about the Humboldt/Mendocino County line. North of here, most commerce was oriented north to Humboldt Bay (or Shelter Cove). South of this division, commerce was oriented to the south using the wagon road from Laytonville to Willits (via Sherwood Valley) or to the west using the port at Westport for the transport of goods into the region and the exporting of wool, redwood shakes, and other local products to markets predominately in the Bay Area.

In 1873, Frank Layton moved to Cahto. Apparently after some disagreements with some of the local residents, Layton moved his blacksmith shop to Long Valley where he purchased 320 acres. In 1880 a post office was opened that bore his name. Although Layton left the area soon after this, the more convenient location in the center of Long Valley, with room for a settlement to grow and with a post office and stage

stop, resulted in many Cahto residents moving into Long Valley. As Mayo (1974:1) notes, "Cahto slowly started to fade away and after a few years it disappeared altogether."

The primary economic activities in the area during this time were related to ranching. As elsewhere, sheep outnumbered cattle during the 1870s and 1880s. Some people also raised turkeys (one article in the *Redwood Advocate* [12/17/1965] describes how one farmer drove 75 turkeys all the way to Santa Rosa). Many of the homesteads depended, to some extent, on hunting and fishing to supplement their subsistence. By this time there were many wild hogs in the area, in addition, deer were also plentiful. One early resident wrote that the remote unroaded region to the north of Laytonville was:

> settled only by here and there a stock raiser, whose habitations are many miles apart...grazing lands are extensive and exceedingly rich. Even the mountains immediately bordering the valleys...abound in the richest of grass, and herds of cattle and sheep are seldom out of site while traveling over them. (Undated letter to E.R. Budd quoted in Herbert n.d.:1978)

Salmon (smoked) were an important staple in local resident's winter diet. One early resident (Mendocino County Historical Society files) wrote that

> in fact there were so many fish that came up the Eel River in the Jackson [Branscomb] Valley area that they could be heard over the roar of the river, as they slapped against each other in their attempt to get upstream. Ranchers hauled wagon loads of them to their homesteads, where they were used for fertilizer.

In the 1880s, Simpson and White opened a sawmill in the Branscomb area, it was the fist in this area. Its main purpose was to supply lumber to local residents. Although redwood logging along the coast was beginning to reach up into the headwaters regions of coastal streams, due to the distance inland from the coast, little in the way of commercial logging took place within the South Fork watershed during this period. Tanbark was first harvested within the area in the 1880s (but not in large quantities).

One of the larger contiguous tracts of Bureau of Land Managment (BLM) within the watershed is in the Cahto Peak area. Adjacent to this is the land owned by the Nature Conservancy--the Coast Range Preserve--together this area totals about 8,000 acres. The BLM lands are for the most part the located along the higher slopes of the area. The Conservancy lands are located to the west of Cahto Peak along the lower slopes of the surrounding mountains and the South Fork passes through this area. During the late 1800s, numerous settlers homesteaded in this area. A comprehensive review of the homestead entries for this area is contained in *The Land-use History of the Coast Range Preserve, Mendocino County, California* (1979) by Sharon Johnson. This study provides an excellent analysis of the past human land-use activities in this area during both the prehistoric and historic periods and the reader is referred to this publication for a detailed overview of location and activities of the homesteads in this area. Important for this overview is the finding (Johnson 1979:16) that the most intensive use of this area was within the "Eel River Corridor" (that is along the lower slopes on terraces adjacent to the river).

Humboldt County: Settlement and Homesteading

Mary Anderson who authored *Backwoods Chronicle* (1985), a history of the southern Humboldt County region, indicated that during her research she was able to find very little on the history of southern Humboldt County. One of the earliest settlers in the southern Humboldt area was James Wood. He homesteaded in what is now the Garberville area and raised hogs. He would then drive them all the way to Red Bluff where top price was paid by Chinese miners (Anderson 1985:25). Another early settler was William Cornelius. In 1867, he acquired the flat that was to become the future town of Redway.

Jacob C. Garber settled on the flat above the river (where present day Garberville is located) in 1873 and constructed a store and established a post office. Prior to this time, the area was known as Dogtown or South Fork.

By the 1878, the county road from Ferndale to Honeydew was completed to the settlement of Briceland (a spur also connected with Shelter Cove). At that time, Briceland was the largest population center in southern Humboldt with about 300 people. Garberville's population at this time was about 100 and it was recognized as an important service and supply center for the farms and ranches of the region. One newspaper article noted that Garber and another merchant Martin had been running pack trains between Garberville and Shelter Cove for over two months and still had over 50 tons of supplies to transport (Suzy Baker Fountain Papers n.d. v 65:254). During this period many of the cattle were driven south to market to the head of the railroad in Ukiah (and later in Willits) to be sold in the Bay Area. During the early years river boats used to come all the way up the South Fork to Myers Landing (Myers Flat).

In 1879, a wagon road was constructed from Briceland to Garberville (the Old Briceland Road). A wagon road (now a portion of Alderpoint Road) was also constructed from Garberville east connecting with the newly constructed Humboldt-Mendocino Wagon Road.

During the period from the mid 1860s to the late 1890s, there was a steady stream of homesteaders and ranchers moving into the southern Humboldt County region. During the early years, sheep ranching was the primary industry in the area that generated capital. During sheep shearing time Anderson (1985:41) notes that there was a steady stream of mule trains (each consisting of about 100 mules) transporting wool to the docks at Shelter Cove.

During the late 1800s the redwood forests of the South Fork watershed remained relatively unlogged. To the west of the watershed, logging was occurring in the creeks draining to the Pacific south of Shelter Cove. At Bear Harbor a wharf was constructed. A railroad brought logs from the interior to Bear Harbor. Several small logging camps were established in the area including Moody, Kinney, and Four Corners. Later, in the early 1900s, a lumber mill, Andersonia (named after the owner Henry Anderson), was constructed near the present town of Piercy with the idea of hauling logs from the western portions of the watershed (the headwaters area near Moody and Kinney). In 1906, Anderson was killed in an accident and the mill never opened despite a substantial investment. Much of the logging in this region (to the east of Piercy) took place after the construction of the Redwood Highway as it provided a way to get the logs to market.

Transportation

Perhaps the most important factor in limiting the development and settlement of the South Fork Watershed during the late 1800s was a lack of adequate transportation infrastructure. There was no wagon road connecting Humboldt County with the counties to the south until the mid 1870s. Eureka was a seaport town and many citizens did not even want a road (the ranchers feared it would increase the number of homesteaders and lumber men did not want to pay for a road that they did not need). Thus, in 1868 a measure to appropriate funds to construct a wagon road was defeated. For that reason, the wagon road from the south ended at Laytonville. At this point, wagon roads led to the east to Round Valley and to the west (generally following the route of the Branscomb Road) to the coast, but to the north, there was only a narrow trail.

Eventually, a road was constructed from Frendale to Petrolia. This road was then extended to Briceland and then to Garberville. In 1875, a wagon road was constructed from Eureka via Kneeland and Bridgeville to Blocksburg. In 1876, the road was finally completed (using Chinese labor) to Laytonville. It was called the Humboldt and Mendocino Wagon Road. It was passable only six months a year and was closed from the first winter rains until late spring (Bunkse 1962:118). From Blocksburg, the road headed south to Alderpoint where the river was forded (it was usually impassable in the winter). From here, the road headed southwest climbing the ridge to Harris. It then headed south to Bell Springs on the divide separating the South Fork and Main Eel watersheds. It continued south along the ridge dropping down to the west into the Rattlesnake Creek watershed (following the route of the Bell Springs Road) and then south (along what is currently the U.S. 101 corridor) to Laytonville.

In the 1890s, a new road was constructed north from Harris along the upper western slope of Pratt Mountain following the ridgeline to where it drops down to the confluence of the South Fork with the main Eel River. This section became known as the Mail Ridge Road. Although it shortened somewhat the distance to Eureka, it was very steep (over 30% slopes in some places) with dangerous switchbacks and was considered little improvement over the old route. Garberville and the surrounding region did not have a direct link with Eureka until 1890 when a wagon road was constructed along the South Fork. Prior to this time it was know as "the most remote town of the [Humboldt] region" (Bunkse 1966:88-89).

While the wagon road at last connected Humboldt County with the south it was not considered a commercial success since traveling to Eureka from the Bay area was faster and easier via steamer and the road was closed much of the year. For this reason, much of the South Fork Watershed within Humboldt County still remained sparsely settled at the turn of the century.

1900-1945

Development and Growth

It was during this era, especially after completion of the Redwood Highway, that the watershed of the South Fork began to experience rapid growth. Transportation was the key to the development of this region and

made possible the large increase in population and the beginning of a new industry within the watershed--tourism.

Mendocino County

In 1906, 200 aces on the west side of the valley was purchased by the Department of Interior and the Laytonville Rancheria was established. In the Branscomb area logging was still not practical due to poor transportation (until completion of the Redwood Highway see below) but some redwood was used to produce railroad ties, stakes, fence posts, and pickets which were profitable to produce and relatively easy to transport via freight wagons to market.

In the early 1900s, the Lovejoy family developed a summer resort at the location of the current Coastal Reserve buildings called Wilderness Lodge. It was a popular vacation spot for those from the Bay Area. It was also the precursor of the large increase in tourism after completion of the Redwood Highway.

The small Valley at Legget was originally called Mitchel Valley. It was isolated and accessible only by trail until completion of the Highway. During the 1950s it was a logging town supporting about 25 small lumber mills.

Humboldt County

In 1915 much of downtown Briceland was destroyed by fire (Anderson 1985:28) but the tanoak mill outside of town was untouched. After collapse of the tanbark industry, the mill closed in 1922. With completion of the Redwood highway, both increased settlement and tourism began to effect the local economy of southern Humboldt County. This era saw a significant increase in the number of tourist facilities. For example, Ben Bow Inn was built during this era and was a popular resort for Bay Area residents.

Major Land-Use Activities

It was only after construction of the Redwood Highway that significant development began to take place within the South Fork Watershed. The following is a brief summary of the kinds of land-use activities that took place during this period.

Mining

Very little activity related to mining has occurred within the watershed. Johnson (1979:158) notes that on

what are now Coast Range Preserve lands, that in 1903-04 two men worked a cinnabar mine for a short period of time but no cinnabar was ever sold. The shaft was about 3-4 feet in diameter and 30 feet deep; Johnson (1979:159) noted that the shaft is still visible.

Red Mountain-Chromite

The only location identified where mining has taken place to any significant degree is in the Red Mountain area located east of Leggett. The earliest reference to mining in this area was found in the *11th Report of the State Mineralogist* (1892:256). The report noted that

> a large deposit of ferruginous rock is said to occur at Red Mountain about 6 miles south of the Humboldt County Line. It has been used as [red] paint by many settlers in that portion of Mendocino County

The upper portions of Red and little Red Mountain contain deposits of chromite ore. With the beginning of World War I, over 100 mining claims were filed in the area and some limited mining took place (the Guthrie Group had the largest number of claims). The reason for this is that chromite was a strategic metal needed in the war effort and a premium was paid that made mining commercially profitable. In 1918, these claims were leased by the Moreland Trucking Company which packed the ore out to the road by mule (probably about 4.5 miles to the Redwood Highway then under construction). Due to the inability to economically transport the mineral to market very little chromite was mined. Figures in the Division of Mines Report (Bulletin 134, 1946:17) indicate the following amounts of chromite were mined in the Red Mountain area.

Year	Tons
1918	522
1920	187
1928	166
1929	39
	914 long tons

One resident of the Long Valley area indicated that during World War I his father packed chrome off Red Mountain on pack horses (Mayo 1974:23).

In 1978, Hanna Mining Company had filed mineral claims on 3,400 acres of BLM land and had bought 5,000 acres in the area east of Legget where it was believed that the laterite soils contained about $1 billion worth of nickel. No mining actually took place but it is likely that some evidence of prospecting is visible in the area.

Data Gap:

It is suggested that further research in this topic may reveal some additional areas where mining and

prospecting took place. Records on mining appear to be rather fragmentary and interviews with long-time residents might provide additional data on where mining and prospecting are likely to have occurred on both on BLM and private lands..

The Tanbark Industry

From about the turn of the century until about 1920, the tanbark industry was at its peak. In the Long Valley region, tanbark was transported by four or six horse teams with tandem wagons. It was hauled to the railroad for about $10 a chord. Eventually, trucks began to haul it for only $3 a load. Mayo (1974:13) notes that a man named Hansen owned a grinder north of Laytonville that processed the tanbark and that it was sacked and shipped to China. It was used in the process for tanning leather. The industry went bust when a chemical process was developed

In the Cahto Peak area, tanbark harvesting reached its peak in the early 1900s. Most of the activity took place further to the west in coastal drainages, however, some harvesting took place in the upper reaches of the western portion of the South Fork watershed and a small amount from (or adjacent) to the homesteads located along the river north of Branscomb (Johnson 1959:153).

There was also a large amount of tanbark harvested in the Briceland area extending west over the divide into the Matole watershed.

Data Gap:

More information is needed on precisely where this activity took place and exactly how tanbark harvesting affected the dynamics of forest succession. It is suggested that interviews with elderly residents of the Long Valley and Briceland areas might shed further light on the kinds of impacts to the environment from this activity.

Timber Harvesting and Management

Nearly all of the forested lands within the South Fork Watershed are held by individuals or corporations. For a review of how these timber lands were transferred from public to private ownership (for both Humboldt and Mendocino Counties) refer to *One Hundred Years of the Redwood Lumber Industry* (Howard Brett Melendy 1952). Although the study traces only the evolution of redwood forests from public to private ownership it does contain insights on how the lands just to the east of the redwood belt--the Douglas-fir tanoak forests were also transferred to private ownership. This transfer of lands to private ownership has implications on how the environment of the watershed has changed over the last century due to the extent

of timber harvesting and the resulting effects to terrestrial and aquatic plant and animal species within the watershed.

It is worth noting that by 1912 nearly all of the redwood forest regions of Humboldt and Mendocino Counties were held by large companies but that as of that time little attention had been paid by these companies to Douglas-fir forest lands as they were considered to be of little value. Within the South Fork watershed redwood commercial logging was rather late in arriving. This was due to the fact that immediately inland from the Mendocino coast and the Humboldt Bay area were dense stands of redwood that were easily (relatively) transported to mills situated on the coast for shipment to markets in the Bay area. After World War I and the completion of the Panama Canal in 1917 increased demand and easier access to markets on the east coast resulted in an increase market for Redwood.

This increase in demand roughly coincided with completion of the Redwood Highway that provided easy access for the first time to the large groves of redwoods located within the South Fork Watershed. When the highway was built, no timber rights were included in the right-of-way. One visitor, a wealthy Chicago philanthropist, who traveled the new Redwood Highway was shocked to find scenes of utter devastation along the highway and wrote that many areas along the road looked "worse that the devastated districts of France" after World War I (Schrepfer 198313).

It was a reaction to these events that led to the formation of the Save-the-Redwoods League and the eventual purchase of a number of large groves of redwoods that eventually became state parks. The largest of these, Humboldt State Redwoods was made possible largely through the donations of a few wealthy individuals especially John Rockefeller.

Data gap:

Due to lack of time, no in-depth assessment of the kinds of effects or precise locations of impacts to the ecosystem from redwood logging is included. It is suggested that a review of logging methods (for example using the creek beds to yard logs) will substantiate the hypothesis that significant long-term damage to the hydrological system of the watershed resulting from poor logging practices is a major factor in the decline of anadromous fish.

Transportation

In the first decade of the 20th century, improvements had been made to the Humboldt and Mendocino Wagon Road and the first auto stages connecting the Bay Area with Eureka made the trip in two days. With the growing popularity of motor vehicles, the Govenor signed the State Highway Act in November of 1910. This Act called for the construction of a state-wide system of highways. One of these routes was to be the Redwood Highway linking the Bay area with Crescent City and Grants Pass, Oregon. When the route through northern Mendocino and southern Humboldt County was surveyed, the South Fork of the Eel River

corridor was chosen. This route was selected since the railroad (the section connecting Eureka to Willits was completed in 1914) already occupied the best route through the main Eel River canyon and for that reason, a road would be prohibitively expensive (Robinson 1964:26). Therefore, the South Fork Canyon was selected even though the route was somewhat longer. At that time, the portion of the South Fork watershed within Humboldt County remained relatively isolated since bad weather still closed sections of the Mail Ridge and Bell Springs Roads during bad weather. In the Laytonville area, autos began traveling the stage road that extended from Willits via Sherwood in 1910. It was noted that during the year 1913, 30 autos passed through the town (Mendocino County Historical Society files).

In 1914, road construction began. During World War II, construction was nearly halted, nevertheless, by 1918 the road was "passable" from Sausalito to Eureka. [One resident of Piercy remembered that the teacher in his small one-room school used to let out class whenever a car passed by since seeing one at this time was such a rare event].

The most difficult portion of the road to construct was the section from Cummings (near the intersection of the Bell Springs Road and U.S. 101) to Dyerville. The road was built through, as Robinson (1964:28) notes, "what was literally virgin wilderness.." For this reason, a haul road was constructed from Leggett to Westport on the coast (now the route of California Highway 1). Steamers could unload in good weather and then supplies were transported by wagon to the construction site. It was not until 1918, that the first steam shovel was used on the job. By 1920, the road was complete however large sections remained unpaved until the mid 1920s.

The construction of the Redwood Highway was a significant event in the history of the South Fork Watershed. Prior to this time, much of the region was isolated and sparsely inhabited. Garberville was the only small community in the central portion of the watershed and was a regional center for the ranching industry. Due to difficulty of access very few tourists ventured into the area. After completion of the new highway, the settlements along the wagon route (Blocksburg, Alderpoint, Harris) began to decline while there was rapid growth along the new highway corridor and every level spot along the river came to be occupied by small settlements or farms and tourism became a major industry (for example French's Camp and the Ben Bow Lodge were favorite tourist destinations).

Land-use Activities and their effects on the Environment

Within the upper reaches of the watershed homesteading, timber harvesting, hunting, feral pigs, the tanbark industry and the use of fire by some homesteaders are some of the primary factors influencing the environment during this era.

Within the Coast Range Preserve, Johnson (1979:36) notes that fire played a role in the past similar to that observed within the North Fork of the Eel watershed (see Keter 1995). For example, on Black Oak Mountain and the adjacent ridge, black oaks are being invaded by Douglas-fir and the oak woodland is rapidly disappearing. Some chaparral area (those in lower more mesophytic areas) dominated by manzanita, ceanothus, shrubby live oaks are also being overtaken by succession to Douglas-fir. When long-time

residents of the Long Valley/Branscomb area were interviewed they also indicated that the area used to be much more open.

Johnson (1959:41) also notes that early residents of the area noted that Roosevelt elk were present and possibly, though unconfirmed, grizzly bear. Mayo (1974:130) notes that Diege Sheldon killed what was probably one of the last elk in the area in 1900 in the area between Branscomb and Westport. Deer were common as were black bear. During the late 1800s and early 1900s many of the local residents trapped mink, otter, racoon, fox, bobcat, and ringtail, since pelts were a valuable commodity (no mention was made of fisher). Also important to note is the fact the local residents indicated that until logging in Douglas-fir forest took place porcupines were not present in the area. One local resident noted he first saw one in the early 1940s (Johnson 1959:44).

One of Johnson's interviewees (1959:210) indicated that prior to the 1955 and 1964 floods that many of the streams were lined with willow, alder, and yew but that the floods destroyed the vegetation. The records also indicate that there was a spring run of salmon in this area. Mayo (1964:41) noted that one individual she interviewed indicated that in the 1920 one resident of Jackson Valley (Branscomb) caught a salmon that weighted 90 pounds and that salmon of this size were common in those days.

It should also be noted that hogs brought in by settlers during this era ranged the hillsides and many became feral. They are still found in this area today. Johnson (1959:45) notes that herpetologists visiting the Preserve have suggested that it is possible that feral pigs have negatively affected reptile and amphibian populations.

1945-
The Modern Era

This section provides a brief overview of the post World War II era and is included to provide a transition and link with the contemporary social data gathered for this Watershed Assessment. The following overview emphasizes Land-use activities and does not include information on specific population centers and areas. The reason for this approach is that growth during this era was rapid and widespread within the South Fork watershed and too complex to document given the limited amount of time provided to accomplish this overview. Therefore, this study provides a thematic overview of the principal land-use activities that took place within the watershed that influenced the environment during this period.

Douglas-fir Forests and Timber Harvesting

It was not until after World War II that timber harvesting began to significantly affect the Douglas-fir forests of the region. With the end of the war there was a rapid expansion of the economy and because of the home loan programs for servicemen there was a substantial increase in demand for lumber. Much of the early

logging activity took place on private lands, but increasingly, National Forest lands (to the east of the watershed) also provided timber. By 1952, there were 258 small lumber mills operating in Humboldt County.

Much of the land with Douglas-fir was interspersed with oak woodlands and was owned by ranchers who by this time had acquired nearly all of the lands within the watershed to the east of the redwood belt. During this period of time, the ranchers often sold the rights to log their land to timber companies unaware of the real value of their timber and the complexities of logging contracts. Since the timber companies did not own the land, they had little motivation (or legal requirement contractually) to log carefully (Dasman 1965:86). For this reason, road construction and logging practices were undertaken with one objective in mind--to reach and harvest as much timber as possible. No consideration was given to either regeneration, slope stability, or future productivity of the land. As Dasman (1965:86) notes, often times when the loggers left, the ranchers found their lands badly damaged or even in useless condition.

It was during this era of the early 1950s that the number of sawmills within the watershed reached its peak. For example, in the Garberville area alone there were nearly 50 small mills. Employment rose, the economy boomed and many loggers and their families (many from Mississippi where a logging boom was going bust and Oklahoma) moved into the area. This boom period lasted little more than two decades and by the late 1960s, nearly all of the old-growth Douglas-fir on private lands within the South Fork watershed had been logged. As the inventory of uncut timberlands declined on private lands attention turned to the vast stands of old-growth timber on BLM and Forest Service Lands (further to the east on Six Rivers National Forest). By the 1970s and 1980s, the timber from public lands within Humboldt County was a significant percentage of the total timber harvested within the county.

Data Gap:

It is suggested that further documentation on the extent of logging (total acres as well as specific drainages) as well as some further study in the methods used (for example tractor logging on extremely steep slopes, no buffers along streams, logging on unstable slopes) would be useful in providing further insight into how anadromous fish have been effected by land-use activities within the watershed.

Recreation and Tourism

With the completion of the Redwood Highway and the creation of a number of State Parks within the watershed, tourism became an increasinly important part of the local economy. The most significant increase in tourism was after World War II.

Data Gap:

It is suggested that in order to provide an adequate overview regarding creation of the State Parks as well

as to provide a better understanding of visitor activities and how State Park managment might affect the ecosystem of the watershed, that efforts be untertaken to work with the cultural resources staff of the California Department of Parks and Recreation to produce brief summaries related to the creation of the various state parks within the watershed.

Ranching

Ranching continued to play an important part in the economies of the small communities within the watershed. Within much of the watershed, sheep continued to out number cattle (although to the east of the watershed within the North Fork and Van Duzen watersheds cattle were preferred). By this time most of the small scale ranching operations had been consolidated and most ranches within the South Fork watershed numbered in the thousands of acres.

Data Gap:

It is suggest that a more complete survey of ranching operations (for example within the Dean Creek, East Branch, and upper Long Valley region) would be useful in tracing the evolution of the grasslands during the historic era as well as providing some insight into the dynamics of oak woodland habitats.

Back to the land Movement

Beginning in the late 1960s (just as the harvesting of timber from private lands was declining) a new a significant land-use activity came to dominate the watershed. The back-to-the land movement (as it was known at the time) consisted of numerous individuals leaving urban centers in an attempt to "get back to nature." Within the South Fork watershed, numerous ranches were subdivided (after the timber had usually been harvested) and parcels of land, most varying between about 20 to 160 acres, were sold. Real estate became a major economic activity (there were numerous Real Estate offices opened at this time in southern Humboldt and northern Mendocino Counties).

The population grew rapidly. In addition, there were significant impacts to the land resulting from the increase in rural development. One of the greatest impacts was from the construction of numerous roads leading to the new parcels of land. Often these developments were poorly designed and the roads were badly engineered (few or no culverts, little consideration for slope stability, no effort to minimize runoff). Many of the new comers (especially by the mid-1970s) were unable to find jobs in the local economy and marijuana cultivation grew into what was (and to some degree still is) the principal economic activity within much of the South Fork watershed. This activity also had significant impacts on the ecosystem of the South Fork watershed (through runoff of chemical fertilizers, poisons used in controlling rodents, erosion, etc.).

Data Gap:

It is suggested that an in-depth study of the recent increased development of small homesteads and the effects of marijuana cultivation on the ecosystem will reveal that significant impacts to the watershed have occurred from these activities rivaling in some locations the impacts from logging and grazing.

Land-use Activities during the post-World War II Period

It is clear from the last section of this study that within the South Fork watershed that impacts from development and population growth accelerated after World War II. Along with logging and grazing (which took place throughout the Eel River Basin) it is the rapid development of the South Fork watershed (including tourism and settlement) that has produced significant impacts to the ecosystem over the last 50 years..

Data Gap:

Although the above summary outlines some of the major impacts to the environment, further research is needed to better quantify and document exactly where specific land-use impacts took place. For example, some drainages are developed and others remain relatively untouched. It is suggested that a better understanding of the kinds and intensity of the impacts from land-use activities within the watershed can be gained by undertaking a comparative study of several sub-watersheds.

Chapter 7

Heritage Resources Management: Status of Site Recordation, Archaeological Surveys, Interpretive Opportunities, and Current Research

The prehistorical and historical heritage resources recorded to date within the North Fork , South Fork, and Van Duzen watersheds are discussed in this section. A summary of the kinds and amount of archaeological survey work that has been conducted within the Basin is also provided.

Cultural Resources Management South Fork of the Eel River

BLM documents (Cultural Resources Files: BLM, Ukiah) indicate that very little in the way of archaeological survey or site recordation has taken place on federal lands within the South Fork Watershed. For example, no major inventory has yet to be undertaken for the Cahto Peak area. Some limited survey has taken place in the Elkhorn Ridge area but no sites have been recorded.

Some archaeological surveys have also taken place on BLM lands in the Red Mountain area. In 1989, approximately 940 aces were surveyed and ten sites (one historic and 9 prehistoric) were recorded in the Red Mountain/Little Red Mountain area (Waechter 1991). Several other surveys smaller in scope have also take place in this area (see Waechter 1991:5 for a listing of these reports). One large survey of isolated BLM parcels was undertaken in 1980 and includes some BLM lands within the South Fork watershed in the both the Red Mountain and Elk Horn Ridge areas (Levulet et al 1980).

The Cahto Peak /Stoten Opening areas and the lower slopes of Elkhorn Ridge along the South Fork of the Eel River are areas of special significance for religious, ceremonial, and the gathering of natural resources for the Cahto (Cultural Resource Files: BLM, Ukiah)

Some archaeological investigations have also taken place within some of the State Parks located along the South Fork of the Eel. For example archaeological surveys have been undertaken at Reynolds Wayside, Smithe Redwoods, Richardsons Grove, and Humboldt Redwoods State Parks and numerous sites have been identified along the river in some of these areas.

There has also been a limited amount of survey work accomplished on private lands--most of this work was undertaken as a result of development. Some sites have been recorded (for example a village site was recorded on Redway Water and Sewer District lands) on private lands in the area. A more detailed overview of cultural resources inventory work for the watershed is beyond the scope of this overview, however, survey and site records for this area are located at the Northwestern Archaeological Information Center at Sonoma

State University.

Data Gap:

Because of the large amount of private lands interspersed with state and federal lands, it is difficult to provide a complete overview of either the approximate number of sites or the amount of land that has been surveyed. The Northwestern Archaeological Information center has site location and survey information for this watershed but no summarizing overview. It is suggested that in order to provide a more useful summary of prehistoric site locations and past survey activity an in-depth overview summarizing the current status of cultural resources work be undertaken for this watershed at some future date.

References Cited

Adam, David P., and G. James West
1983 Temperatures and Precipitation Estimates Through the Last Glacial Cycle from Clear Lake, California. *Science* 219: 168-170.

Anderson, Mary Siler
1985 Backwoods Chronicle.

Anderson, Peter
1948 Sheep Industry of Humboldt County. Ms. on file Humboldt Room, Humboldt State University, Arcata.

Asbill, Frank
ms The Last of the West. Unpublished Manuscript in five volumes. Mendocino Historical Society, Ukiah, CA.

Barbour, Michael G. and Jack Major
1977 Terrestrial Vegetation of California. John Wiley and Sons, New York.

Baumhoff, Martin A.
1958 California Athabascan Groups. *Anthropological Records* 16, (5): 157-237.

1963 Ecological Determinants of Aboriginal California Populations. *University Publications in American Archaeology and Ethnography*, 49 (2):155-236.

Bledsoe, A. J.
1885 Indian Wars of Northwest California. BioBooks, Oakland. (Reprint.)

Bunkse, Edmund
1962 The Humboldt Bay Region: A Study of Pioneer Transportation. MS. On file Humboldt State University, Arcata, CA.

Burcham, L. T.
1981 California Range Land. Center for Archaeological Research at Davis, Publication No. 7. University of California, Davis. (Reprint.)

Carranco, Lynwood, and Estle Beard
1981 Genocide and Vendetta: The Round Valley Wars of Northern California. University of Oklahoma Press, Norman.

Chestnut, V. K.
1974 Plants Used by the Indians of Mendocino County, California. Reprint by the Mendocino Historical Society, Ukiah, CA.

Curtis, Edward S.
1924 The North American Indian: Volume 13, "The Wailaki". Johnson Reprint Corporation, New York.

Dasman, Raymond
1965 The Destruction of California. McMillian Book Company, New York.

Davy, Joseph Burtt
1902 Stock Ranges of Northwest California: Notes on the Grasses and Forage Plants and Range Conditions. U.S. Government Printing Office. Washington, D.C.

Eidsness, Janet P.
1985 Prehistoric Archaeology Within Chimariko Territory, Northwestern California. Unpublished Master's thesis, Cultural Resources Management, Sonoma State University, Rohnert Park, CA.

Elliot, W.W.
1881 History of Humboldt County Including Biographical Sketches. W.W. Elliot Publishers. San Francisco.

Elsasser, Albert B.
1978 Matole, Nongatl, Sinkyone, Lassik. In Handbook of the Indians of California, Volume 8, Robert F. Heizer ed. Smithsonian Institution, Washington D.C. pp. 190-204.

Essene, Frank

MS Unpublished ethnographic field notes on Round Valley Reservation. Manuscript on file, Bancroft Library, University of California, Berkeley.

1942 Cultural Element Distribution XXI Round Valley. *Anthropological Records* 8(1). University of California, Berkeley.

Foster, George
1944 A Summary of Yuki Culture. *Anthropological Records* 5(3). University of California, Berkeley.

Fountain, Suzy Baker
MS The Papers of Suzy Baker Fountain. Unpublished manuscript on file, Humboldt State University, Arcata, CA.

Goddard, P. E.
1923 The Habitat of the Wailaki. *University of California Publications in American Archaeology and Ethnology*, XX:95-109.

1924 The Habitat of the Pitch Indians, A Wailaki Division. *University of California Publications in American Archaeology and Ethnology*, 7 (4):217-225.

Gould, Richard A.
1975 Ecology and Adaptive Response Among the Tolowa Indians of California. *Journal of California Anthropology*, (2)2 148-170.

Griffin, James, and William Critchfield
1972 The Distribution of Forest Trees in California. Research Paper PSW 82/1972. USDA Forest Service, Pacific Southwest Research Station, Berkeley, CA.

Hamann, Skee
n.d. Edith Murphy: Pioneer Botanist in Mendocino. Mendocino Historical Society, Ukiah, CA.

Heady, Harold F.
1977 In Terrestrial Vegetation of California. Michael G. Barbour and Jack Major. John Wiley and Sons, New York.

Herbert, Rand F., Alan M. Paterson, Stephen R. Wee
n.d. The Historical Development of Interior Sections of Humboldt and Mendocino Counties. Report prepared for the Bureau of Land Management, Ukiah District. On file, BLM office, Ukiah, CA.

Hildebrandt William R., and John F. Hayes
1993 Settlement Pattern Change in the Mountains of Northwest California: A View from Pilot Ridge. In There Grows a Green Tree: Papers in Honor of David A. Fredrickson, pp. 107-120. Publication Number 11, Center for Archaeological Research at Davis, University of California, Davis.

Holson, John J.
1986 Data Recovery at CA-MEN-268, CA-MEN320/643, and CA-MEN-321, Mendocino County, California. Manuscript on file Cultural Resources facility Sonoma State University.

Holson John J. and David Fredrickson
1980 Archaeological Survey of County Road 338/Forest Highway 7 and Archaeological Investigation of CA-MEN-320/643 Covelo District, Mendocino National Forest. Manuscript on file Heritage Resources Mendocino National Forest, Willows, CA.

Huberland, Amy
1993 Archaeological Investigations at CA-MEN-995, Beaver Glade Station, Mendocino National Forest. Dames & Moore. Submitted to USDA Forest Service, Willows, CA.

Jackson, Thomas L.
1976 Middle Eel Planning Unit Archaeological Survey. Report on file, USDA Forest Service, Mendocino National Forest, Willows, CA.

Johnson, Sharon Grace
1979 The Land-use History of the Coast Range Preserve, Mendocino, California. Ms. on file San Francisco State University, San Francisco.

Keter, Thomas S.

1990 Settlement and Conflict: The Refuge Period and Historic Settlement in the North Fork of the Eel River Basin: 1854-1864. Paper presented at the Annual Meeting of the Society for California Archaeology, Foster City. On file, Six Rivers National Forest, Eureka, CA.

1993 Territorial Relationships of the Inland Southern Athabascans: Some New Perspectives. In There Grows a Green Tree: Papers in Honor of David A. Fredrickson, pp. 37-51. Publication Number 11, Center for Archaeological Research at Davis, University of California, Davis.

1994 The Ranching Period in the North Fork of the Eel River Basin: 1865-1905. Paper presented at the Annual Meeting of the Society for California Archaeology, Ventura. On file, Six Rivers National Forest, Eureka, CA.

1995 Environmental History and Cultural Ecology of the North Fork of the Eel River Basin, California. U.S. Department of Agriculture, Forest Service, Pacific Southwest Region. Publication R5-EM-TP-002.

King, Tom

1974 Manos on the Mountain: Borax Lake Pattern High Altitude Settlement and Subsistence In the North Coast Ranges of California. Report on file USDA Forest Service, Mendocino National Forest, Willows, CA.

Levulett, Valerie A., and Talbot B. Ruhstaller, Linda A. Bell

1980 Class III Inventory of Northwestern California Timber Tracts within Sustained Yield Unit 13 Del Norte, Humboldt, Trinity and Mendocino Counties. MS. On file BLM Ukiah, CA.

Lowden,

1894 Map of Trinity County. Trinity County Historical Society. Weaverville.

Lynn, Rena

1977 The Story of the Stolen Valley. L&S Publishing, Willits, CA.

Melendy, Howard Brett

1952 One Hundred Years of the Redwood Lumber Industry. MS. On file Humboldt Room,

Merriam, C. Hart

MS Unpublished ethnographic field notes. Manuscript on file at the Bancroft Library, University of California, Berkeley.

Miller, Leona

MS Collected letters of Remembrances of Early Settlers in Southern Trinity County. Manuscript in authors possession.

Miller, Virginia

1976 The 1870 Ghost Dance and the Methodists: An Unexpected Turn of Events in Round Valley. *Journal of California Anthropology* 3(2) 66-73.

Murphy, Edith

MS Collected Papers. Manuscript on file, Mendocino Historical Society, Ukiah, CA.

1941 Out of the Past: A True Indian Story Told by Lucy Young, of Round Valley Indian Reservation. *California Historical Society Quarterly*, Vol 20.

Nordhoff, Charles

1874 Northern California, Oregon, and the Sandwich Islands. Harper and Brothers. New York.

Paterson, Alan M. and Rand F. Herbert and Stephen R. Wee

1978 An Historical Overview of California's North Coast Region. Ms. on file BLM, Ukiah, Ca.

Peak, Ann S. and Daryl Noble

1983 Archaeological Investigations on CA-MEN-1827, Mendocino county, California. Prepared for Georgia-Pacific. MS on file Georgia Pacific Corporation, Ft. Bragg, CA.

Powers, Stephen

1976 Tribes of California. University of California Press. Berkeley.

Pyne, Stephen J.

1982 Fire in America: A Cultural History of Wildland and Rural Fire. Princeton University Press, Princeton, New Jersey.

Rahm, Neal M.

1943 Historical Data on the Effect on the Deer Populations of Natural Conditions, Disease, Hunting, and Predation in Trinity County--Particularly the Mad River Ranger District. On File Six Rivers National Forest, Eureka, CA.

Robb, Walter

1978 South of the South Fork. Trinity County Historical Society, Weaverville, CA.

Robinson, John

1964 The Redwood Highway. *California Highways and Public Works* (3 parts May-June, July-August, September-October). MS on file CAL TRANS, Eureka, Ca

Schrepfer, Susan R.

1983 Fight to Save the Redwoods: A History of Environmental Reform 1917-1978. University of Wisconsin Press, Madison, WI..

Simons, Dwight D.

1983 Holocene Environmental Changes. In Archaeological Investigations on Pilot Ridge

Six Rivers National Forest. On file, Six Rivers National Forest, Eureka, CA.

Waechter, Sharon and Thomas M. Origer
1992 Archaeological Investigations at Pilil (CA-MEN-1793), on the Black Butte River, Mendocino National Forest. Report on file Mendocino National Forest, Willows, CA.

West, James G.
1983a Holocene Environmental Changes. In Archaeological Investigations on Pilot Ridge Six Rivers National Forest, pp. 3.17-3.31. On file, Six Rivers National Forest, Eureka, CA.

1983b Pollen Analysis of Sediments from Lily Pond Lower Letts Valley, Mendocino National Forest California: a Record of Holocene Vegetation and Climate. Manuscript on file, Mendocino National Forest, Willows, CA.

1988 Holocene Vegetation and Climatic History of the Trinity River Region; the Pollen Record. In Cox Bar (CA-TRI-1008): A Borax Lake Pattern site on the Trinity River, California, Elaine Sundahl, pp. 13-28. Manuscript on file at the Shasta College Archaeology Lab, Redding, CA.

1990 Holocene Fossil Pollen Records of Douglas-fir in Northwest California: Reconstruction of Past Climate. In Proceedings of the Sixth Annual Pacific Climate Workshop, J.L. Betacourt and A. M. MacKay, eds., pp. 119-122. California Dept. of Water Resources, Interagency Ecological Studies Program. Technical Report 23.

1991 Pollen Analysis of A-M Lake Mendocino National Forest. Manuscript on file, Mendocino National Forest, Willows, CA..

1993 The Late Pliestocene-Holocene Pollen Record and Prehistory of California's North Coast Ranges. In There Grows a Green Tree: Papers in Honor of David A. Fredrickson, pp. 219-236. Publication Number 11, Center for Archaeological Research at Davis, University of California, Davis.

Whistler, Kenneth
1979 Linguistic Prehistory of the Northwest California Coastal Area. In A Study of Cultural Resources in Redwood National Park, Polly McW. Bickel. MS on file Redwood National Park, Arcata, CA.

Interviews:

Interviews cited are on file, Cultural Resources Department, Six Rivers National Forest, Eureka.

Mendocino Historical Society (Ukiah)

Manuscripts and Collections:
Frank Asbill Ms. The Last of the West
Estle Beard Collection (5 Boxes)
John Wathen Ms. (Box 4 Estle Beard Collection)

Trinity County Historical Society (Weaverville)
Southern Trinity County Files documents listed by number. STF #4, #32,#53

Periodicals

Trinity Yearbook. Trinity County Historical Society. Weaverville, CA. 1956, 1957, 1960 1961, 1971.

Newspapers

Alta California, San Francisco
Daily Evening Bulletin, Eureka
Examiner, San Francisco
Humboldt Times, Eureka
Trinity Journal, Weaverville

APPENDIX D

Appendix D

Progress Report

As of 10/30/96

Project name: South Fork Eel

#022-2506-111-126

Copies sent to:

USDI, Bureau of Land Management

David Largent, Project Director

H.S.U. Foundation Office

Fungal Inventory, SF Eel
BLMFUN1

Fungal Inventory-SF Eel	mr1	mr2	bc1	bp1	nb1	br1	br2	br3	lbc	lbr	ssc	od1	sf1	sf2	sf3	cp1	cp2	cp3	rc	sp	lp	bp2			sum
Pathogens																									
Colesporium (baccharis)			1											1											2
Cryptoporus volvatus											1														1
Fometopsis cajandri	1					1	1				1											1			5
Fometopsis pinicola									1		1											1			3
Laetiporus sulfureus																1									1
Lenzites saepiaria						1																			1
Mycospaerella arbuticola			1	1	1				1					1											5
Phaeolus schwienitzii	1	1										1	1			1						1			6
Phellinus chrysoloma											1														1
Phellinus pini	1										1			1											3
Phoradendron flavescens																1									1
Pseudomonas pseudotsuga	1		1		1		1			1		1		1		1									8
Schizophyllum commune						1																			1
Scirrhia pini			1																						1
Stereum complicatum	1	1		1	1	1		1		1	1	1	1		1	1		1							13
Stereum hirsutum			1		1	1	1	1		1	1		1		1	1					1				11
Trametes versicolor						1	1			1	1		1												5
Trichaptum abietinum	1																								1
Verticicladiella wagnerii	1																								1
																									0
																									0
																									0
																									0
Plot totals	**7**	**2**	**4**	**2**	**4**	**6**	**4**	**2**	**2**	**4**	**7**	**3**	**4**	**3**	**2**	**6**	**0**	**1**	**0**	**0**	**1**	**3**			**67**
Mushrooms																									
Amanita calyptroderma				1	1						1			1											4
Amanita constricta				1																		1			2
Amanita muscaria var. formosa											1	1		1											3
Amanita rubescens																1									1
Amanita silvicola												1													1
Amanita vaginata											1					1									2
Armillaria mellea				1						1	1					1									4
Boletus edulis																		1							1
Collybia cirrhata									1																1
Conocybe tenera	1								1																2
Copinus lagopus								1		1				1		1						1			5
Flammulina vellutipes				1	1					1	1			1											5
Galerina sp. s									1			1													2
Galerina sp. lg.								1																	1

Fungal Inventory, SF Eel
BLMFUN1

Hyphaloma fasciculare										1	1											1			3
Lepiota clypeolaria						1																			1
Marasmius androsaceus								1		1	1			1											4
Mycena alcalina				1	1				1	1					1										5
Mycena purpureofusca			1							1		1										1			4
Mycena murina																						1			1
Paxillus atrotomentosous																						1			1
Phytoconis ericetorim														1											1
Psathyrella gracilis									1																1
Russala albonigra																						1			1
Russula brevipes																1									1
Russula densifolia					1																				1
Russula xerampelina																1									1
Strobilarus trullisatus	1	1	1		1						1					1						1			7
Suillus brevipes																1									1
Suillus lakii					1																				1
Tubaria furfuracea									1																1
Xeromphalina fulvipes	1																					1			2
																									0
																									0
																									0
																									0
																									0
																									0
Other Fungi																									0
Astraeus grandis														1											1
Byssocorticium pulchrellum								1																	1
Daldinia sp.				1		1																			2
Exidia glandulosa										1															1
Nidularia sp.									1				1	1											3
Scutellinia scutellata						1								1											2
Tremella mesenterica	1									1						1									3
																									0
																									0
ROD Plants																									0
Allotropa virgata						1																			1
Scoliopus bigelovii	1																								1
Plot totals	**12**	**3**	**6**	**8**	**10**	**9**	**5**	**6**	**9**	**13**	**15**	**7**	**5**	**12**	**3**	**15**	**0**	**2**	**0**	**0**	**1**	**12**			**163**

Lichen Inventory, SF Eel
BLMLCH

Lichen Inventory-SF Eel	mr1	mr2	bc	bp	nb	br1	br2	br3	lbc	lbr	ssc	od	sf1	sf2	sf3	cp1	cp2	cp3	rc	sp	lp			sum
Alectoria imshaugii																				1				1
Alectoria lata																				1				1
Alectoria sarmentosa						1			1					1						1	1			5
Bryoria fremontii			1											1	1				1	1	1			6
Cladina portentosa	1																							1
Cladina rangiferina														1										1
Cladonia carassensis						1								1										2
Cladonia ecmocina						1			1	1			1	1										5
Cladonia fimbriata			1								1		1	1		1								5
Cladonia furcata												1	1	1	1									4
Cladonia ochrachlora			1		1	1			1						1						1			6
Cladonia pyxidata		1				1	1					1	1	1						1				7
Cladonia squamosus	1		1			1			1	1			1	1	1									8
Cladonia transcendens	1	1										1	1											4
Collema furfuraceum												1				1								2
Collema nigrescens	1									1						1	1							4
Diploschistes scruposus							1																	1
Esserlingeriana idahoensis	1	1	1		1		1			1	1				1	1				1	1			11
Evernia prunastri					1		1			1			1	1		1								6
Hypogymnia enteromorpha	1	1		1	1	1						1		1		1								8
Hypogymnia heterophylla																					1			1
Hypogymnia imshaugii			1	1	1	1		1	1	1	1			1	1	1	1		1	1	1			15
Hypogymnia inactiva	1	1	1	1	1	1	1	1			1	1		1	1	1			1		1			15
Hypogymnia metaphysodes		1					1	1				1												4
Hypogymnia occidentalis	1	1	1		1	1	1	1		1	1	1	1	1		1			1		1			15
Hypogymnia physodes					1	1						1							1					4
Hypogymnia rugosa						1	1			1														3
Hypogymnia tubulosa													1	1		1								3
Icmadophila ericetorium		1			1	1	1	1	1	1	1													8
Lepraria membranacea						1							1											2
Lepraria chlorina														1										1
Leptochidium albociliatum	1		1													1	1	1						5
Leptogium californicum			1		1	1	1		1				1	1										7
Leptogium corniculata	1		1		1	1	1		1	1	1	1	1	1	1									12
Leptogium lichenoides		1	1							1			1			1	1	1	1		1			9
Leptogium palmatum	1		1				1		1		1			1					1		1			8
Leptogium saturninum										1								1						2
Letharia columbiana																			1	1	1			3
Letharia vulpina	1					1						1				1				1				5
Lobaria hallii		1								1	1					1			1					5
Lobaria pulmonaria	1	1			1		1	1		1	1	1		1		1			1					11
Lobaria scrobiculata																1			1					2
Melanelia subolivacea										1			1			1			1					4
Melanelia subelegantula					1			1																2
Nephroma helveticum										1	1					1	1							4
Nephroma resupinatum										1						1			1					3
Ochrolechia pallescens	1	1	1	1	1	1		1		1	1	1	1	1		1	1							14
Ochrolechia upsaliensis																			1					1
Parmelia kerguelensis	1	1			1				1			1	1	1		1		1	1		1			11

Lichens cont.	mr1	mr2	bc	bp	nb	br1	br2	br3	lbc	lbr	ssc	od	sf1	sf2	sf3	cp1	cp2	cp3	rc	sp	lp			
Parmelia squarrosa	1						1			1	1	1		1		1			1					8
Parmelia sulcata	1	1	1	1	1	1	1	1		1	1	1	1	1	1	1					1			16
Parmeliella praetermissa			1				1				1		1	1				1						6
Parmelina quercina			1															1						2
Parmotrema arnoldii		1										1												2
Parmotrema chinense	1						1																	2
Peltigera apthosa							1							1										2
Peltigera canina	1	1	1	1		1	1	1	1	1			1	1			1	1						13
Peltigera collina	1	1					1	1		1	1	1	1	1		1		1						11
Peltigera polydactyla					1		1			1				1										4
Peltigera preatextata					1		1		1				1	1										5
Peltigera venosa			1											1										2
Phaeophyscia ciliata																1								1
Physcia adscendens					1																			1
Physcia aipolia					1					1	1		1	1		1								6
Physcia biziana																1		1						2
Physcia callosa																	1	1						2
Physcia dememtei																1								1
Physcia semipinnata														1										1
Physcia stellaris																	1							1
Physcia tenella					1											1								2
Physconia detersa																1								1
Physconia distorta																1								1
Pilophoron aciculare									1					1										2
Platismatia glauca	1	1	1		1	1	1			1	1			1	1	1	1		1	1	1			15
Platismatia herrii	1		1		1						1	1		1	1	1			1	1	1			11
Platismatia norvegica	1																							1
Platismatia stenophylla	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1		1	1	1			20
Polychidium musicola																	1							1
Pseudocyphellaria anomala	1	1					1	1		1	1	1	1	1	1	1		1	1					13
Pseudocyphellaria anthraspis	1	1	1		1		1	1		1	1	1		1		1	1	1						13
Psuedephebe pubescens											1						1							2
Ramalina dilacerata								1																1
Ramalina farinacea		1			1		1	1		1		1	1	1	1	1								10
Spaerophorus globosus	1					1	1				1	1		1	1	1			1					9
Sticta fuliginosa	1		1				1	1		1		1												6
Tuckermannopsis canadensis					1											1			1	1				4
Tuckermannopsis chlorophylla		1						1		1				1		1			1		1			7
Tuckermannopsis merrillii					1			1							1	1			1	1				6
Tuckermannopsis orbata	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1		1	1	1			20
Tuckermannopsis platyphylla											1				1	1			1	1	1			6
Umbilicaria hyperborea																1	1							2
Usnea arizonica		1																						1
Usnea cavernosa				1							1					1					1			4
Usnea ceratina	1		1	1	1	1	1		1	1	1	1		1		1					1			13
Usnea diplotypus	1	1			1	1		1		1	1	1	1	1	1	1			1	1	1			15
Usnea glabrata	1	1				1														1				4
Usnea substerilis														1										1
Usnea wirthii						1																		1

Lichen Inventory, SF Eel
BLMLCH

Lichens cont.	mr1	mr2	bc	bp	nb	br1	br2	br3	lbc	lbr	ssc	od	sf1	sf2	sf3	cp1	cp2	cp3	rc	sp	lp			
Xanthoparmelia cumberlandia								1								1								2
Xanthoparmelia mexicana			1																					1
Xanthoria polycarpa																1								1
																								0

Moss Inventory, SF Eel
BLMMS

Bryophyte Inv.-SF Eel	mr1	mr2	bc1	bp1	nb1	br1	br2	br3	lbc	lbr	ssc	od1	sf1	sf2	sf3	cp1	cp2	cp3	rc	sp	lp			sum
Anthoceros punctatus	1		1		1	1	1		1		1	1		1										9
Anacolia menziesii			1																					1
Antitrichia californica	1		1		1					1	1	1		1		1		1	1		1			11
Atrichum selwynii	1		1	1	1	1		1	1	1	1	1	1	1	1	1					1			15
Aulacomnium androgynum			1						1		1				1	1				1				6
Brachythecium albicans																1								1
Brachythecium asperrimum	1													1		1			1					4
Brachythecium fendleri	1	1			1	1	1	1	1	1	1	1	1	1		1			1		1			15
Brachythecium velutinum	1		1	1			1				1				1	1		1			1			9
Brachythecium sp.									1															1
Bryoerthrophyllum							1						1											2
Bryum argentium							1																	1
Ceratodon purpureus			1																					1
Claopodium whippleanum			1	1		1	1			1	1	1	1	1	1									10
Conocephallum conicum													1											1
Dendroalsia abietina	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1		1			1			18
Dicranoweisia cirrata	1		1	1		1	1		1		1	1	1	1	1	1				1	1			14
Dicranoweisia crispula						1														1				2
Dicranum fuscescens						1							1	1										3
Dicranum howelii														1										1
Didymodon tophaceus			1																					1
Epipterygium tozeri	1			1		1																		3
Eurhynchium oreganum	1			1	1	1			1	1	1	1	1			1								10
Frullania californica												1												1
Frullania nisquallensis					1		1			1		1		1	1									6
Grimmia tenerrima																	1							1
Homalothecium aeneum			1		1	1				1	1					1	1	1	1					9
Homalthecium nuttallii	1		1		1		1			1		1	1	1	1	1		1	1					12
Hypnum circinale	1	1	1			1				1	1		1		1	1								9
Hypnum subimponens	1		1						1	1		1	1	1							1			8
Isothecium cristatum	1	1	1	1	1	1	1		1	1	1	1	1	1	1	1		1	1		1			18
Isothecium stoloniferum						1		1				1	1											4
Lepidozia reptans						1	1							1										3
Lescuraea patens	1		1		1	1	1	1	1			1	1	1	1	1		1						13
Lunularia cruciata													1											1
Leucolepis acanthoneura	1					1																		2
Metaneckera menziesii													1											1
Neckera douglasii	1					1	1																	3
Orthodicranum strictum	1				1	1	1		1		1		1	1		1								9
Orthotrichum laevigatum				1																				1
Orthotrichum lyellii	1		1	1	1	1		1		1	1	1	1	1	1	1	1	1	1		1			17
Phaeoceros laevis	1		1						1	1				1										5
Plagiomnium insigne				1			1																	2
Pohlia wahlenbergii						1								1							1			3
Polytrichum juniperinum	1		1			1	1	1	1	1	1			1										9
Porella navicularis	1	1				1	1		1	1	1	1	1	1	1	1		1	1		1			15
Pseudotaxiphyllum elegans	1										1													2
Pterigynandrum filiforme			1										1											2
Pterygonium gracile										1			1		1		1							4

Moss Inventory, SF Eel
BLMMS

Bryophyte Inv.-SF Eel	mr1	mr2	bc1	bp1	nb1	br1	br2	br3	lbc	lbr	ssc	od1	sf1	sf2	sf3	cp1	cp2	cp3	rc	sp	lp			
Racomitrium aciculare			1																					1
Racomitrium heterostichum	1		1		1			1				1	1				1		1		1			9
Racomitrium varium									1					1										2
Radula bolanderii						1							1											2
Scleropodium obtusifolium						1							1	1	1	1								5
Scouleria aquatica													1											1
Timmiella crassinerva						1																		1
Tortella torulosa	1					1	1		1	1	1	1	1	1		1		1						11
Tortula princeps													1			1	1	1						4
Tortula ruralis								1	1							1								3
																								0
																								0
Plot totals	**25**	**5**	**23**	**11**	**14**	**27**	**19**	**9**	**18**	**18**	**19**	**19**	**28**	**25**	**15**	**22**	**6**	**11**	**9**	**3**	**12**	**0**	**0**	**338**

APPENDIX E

Appendix E
Fire Effects, Suppresion, and Fuel Treatments

Fire Effects

The presettlement composition and structure of Pacific Northwest forests were greatly influenced by fire. Fire plays a direct role in processes associated with vegetation succession, nutrient cycling, and soil structure and stability. However, fire is a dynamic process. Ecosystem response to fire will vary depending on the amounts of organic matter consumed, season of burn, time lapse since the last burn, and the many variables associated with biotic, physical, climatic, and anthropogenic features of an ecosystem (Kauffman 1990).

In addition to genetically adapted traits (e.g., serotinous cones, sprouting from below-ground plant organs), several other factors will influence plant response to fire. Characteristics of the individual plant include age and vigor. Specific adaptations and the capacity to survive a fire often will change with age. Environmental conditions which influence survival include type of fire (surface or crown fire), fire frequency or return interval, season of burn (during the active or the dormant growing season), fuel consumption, fire intensity, physical site characteristics (slope, aspect, soil type), and associated species.

It is important for forest managers to understand the role of fire in forest systems, vegetation adaptations to survival in fire regimes, and the effects of altering fire regimes on vegetation composition. Alterations of fire regime have resulted from active fire suppression in this watershed which historically had a much more frequent fire return interval. Fire regimes have also been altered by management activities which shortened fire return intervals (e.g., logging followed by slash burning) or lengthened fire return intervals (e.g., aggressive fire suppression). These potential fire effects need to be considered in terms of wildfires and prescribed burns. Considering the predominant tree species listed for the South Fork Eel Watershed, Appendix A is a brief, generalized discussion of potential fire effects.

Within Humboldt Redwoods State Park several mitigations and special treatment constraints have been identified regarding fire effects (which could be considered elsewhere). The degree of bark char and scorch are of primary importance in the vegetation communities that have mature redwood and Douglas-fir for both mortality and aesthetic reasons. Heavily charred and scorched Douglas-fir and redwood, although not killed by fire initially, may be greatly weakened and subject to pathogen or insect attack, particularly on marginal sites. For aesthetic reasons, bark char and scorch control is important near areas that are frequented by the park visitor (near main trails and roads). However, an important goal of the Management Plan is to open up the forest and woodland plant communities by thinning out dense stands of seedling and sapling fir, thereby increasing the amount of light through the forest canopy. Mortality (scorching) of the smaller and medium height fir trees is a prescribed burn objective in these plant communities (Stuart and others. 1993).

Suppression and Fuel Treatment Strategies

Fuel treatments, alternative suppression strategies, and silvicultural techniques need to be investigated with the goal of returning to "natural" fire regimes of frequent, low intensity fires. Large fires may have historically occurred, but their intensities are increasing dramatically.

Alternative suppression strategies, including confinement and containment (rather than complete control), should be considered as a way to reduce the long term hazard for this area. These alternatives should especially be considered in areas that have already been designated as good candidates for large area understory burns. Alternative suppression strategies have been documented for the Red Mountain ACEC and the Angelo Coast Range Reserve and Elder Creek ACEC (Appendix B). Suppression actions would use strategies and tactics that strive to protect the specific attributes of these two specific areas.

Other alternative strategies that should be considered for use (Appendix C) are based on the Minimum Impact Suppression Tactics (MIST) developed in R1 primarily for use in wilderness areas, proposed wilderness, or other lands with similar land management objectives. The intention of these tactics was to reduce fire suppression or holding impacts on resources while insuring the actions taken were timely and effective. These low impact tactics for suppression, logistics, aviation, hazardous materials, rehabilitation, and demobilization should be considered throughout the watershed and carried out if at all possible in Late Successional Reserves (LSRs) and any other areas with significant resource concerns. These low impact suppression actions may result in an increase in the amount of time spent watching, rather than disturbing, a dying fire to insure it does not rise

again. They may also involve additional rehabilitation measures on the site that were not previously carried out. Considering the risk and hazard within this watershed, preattack planning should also be addressed to determine the need and placement of water sources, helispots, communication links, etc.

Vegetative management and/or natural fuels reduction needs to be considered throughout the watershed, taking into consideration potential risk, hazard, and values. Removing ladder fuels, through thinning, mechanical treatment, or understory burning could reduce the potential for crown fires. Brackebusch (1973) emphasized the importance of developing hazard reduction plans for large areas that incorporate a variety of strategies. He suggested that combinations of fuelbreaks, vegetation mosaics, and project-level treatment would be more cost effective than project-level treatment alone.

Fuelbreak construction would entail manipulation of live vegetation by thinning young conifers, limbing larger trees and cutting brush. Heavy fuel concentrations could be hand piled and lighter fuels could be understory burned. Strategically placed shaded fuelbreaks could be used to help reduce the impacts of wildland fires and help in the implementation of planned understory burning projects. Fuelbreaks could reduce the need to construct wide dozer firelines typically utilized for suppressing large fires. This could also reduce potential impacts to resources from heavy equipment and the need for intensive rehabilitation efforts. Shaded fuelbreaks could also be used to isolate high risk areas where understory burning is not desired or practical (e.g., LSRs, plantations, adjacent to communities, Botanical Areas). Prescribed fire should be used to help reintroduce fire into the ecosystem and to promote forest health by reducing accumulated fuels that contribute to stand replacing fire events.

Shaded fuelbreaks and large area understory burns are used as anchor points and added onto after the initial burn. In order to keep fire within its natural return frequency a reburn schedule would have to planned for and committed to. After the initial burn, future treatments will require much less planning and personnel, and, therefore, the associated costs would be much reduced. Under more moderate weather conditions some wildfires can respond in a similar fashion to a prescribed burn, with resulting low to moderate fire severity.

The shift in emphasis from broadcast burning of clearcuts to underburning includes some inherent risks. Large areas may burn in mosaics with varying fire intensity and severity. While this may mimic natural underburning, there are risks associated with retaining coarse woody debris and preserving remaining trees and snags. The likelihood for reburning, spotting, and the killing of some trees is increased as is the possibility for a prescribed burn to escape the planned burn area. But it is anticipated that by prescribed burning under advantageous weather conditions, subsequent detrimental wildfire effects may be reduced due to a decreased amount of available fuel and a breakup of the fuel ladder.

Resource management activities should be designed and implemented so that the wildfire hazard level of the surrounding area is not increased to an unacceptable level. Concentrations of fuels created by management activities should be reduced to acceptable levels and arrangements based on the site specific wildfire risk and the needs of other resources. The selected treatment methods should consider resource values and environmental limitations (for example, topography, accessibility) as well as costs. Large area burns should be the norm (both for economic and ecological efficiency) and some degree of mortality must be accepted as a natural outcome of having fire play its natural role in the ecosystem. Killed trees could either be left standing to provide snags and downed logs later on or they could be removed.

The most important prescribed burning priority at Humboldt Redwoods State Park is to reduce the intrusion of Douglas-fir and a variety of shrub species into prairies. Treating the prairies is a high priority because they are more dynamic and hence change more rapidly than the forested vegetation types. Prescribed burning will help reverse this trend by killing and weakening Douglas-fir and shrub species, and by gradually opening up the denser vegetation encouraging the establishment of native grasses and herbaceous species. Also, prairie burning can be completed relatively quickly and easily compared to forest burning.

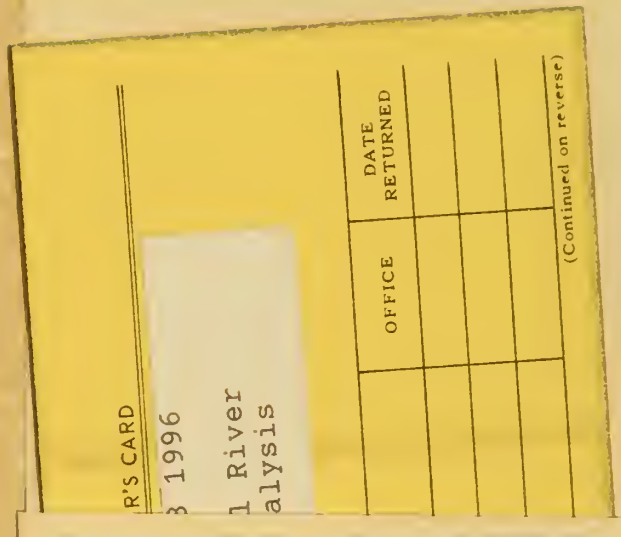
A second prescribed burning priority is to break up horizontal and vertical fuel continuity in the upper Bull Creek watershed. This area is dominated by dense stands of young conifers and mixed evergreen hardwood trees that became established following clearcutting or wildfire in the 1950's and 1960's. In most cases tree canopies overlap and there is a continuous fuel ladder from the surface fuels into tree crowns. Prescribed fire in conjunction with thinning and pruning can lessen the hazard of a catastrophic wildfire. The highest priority for treatment would be along the Mattole Road from Cuneo Creek to Panther Gap. Lower priority areas would include buffers adjacent to secondary roads and trails throughout the upper watershed. It may also be necessary to treat unobtrusively certain ridges. The objective would not be to create a bare fuel break, but to disrupt the continuous fuel beds. This can be accomplished while still keeping trees in place through a shaded fuel break.

A third prescribed burning priority is to reduce live fuels (especially evergreen huckleberry) and heavy fuel loads within the forest vegetation types to prevent extreme impacts of wildfire and to facilitate the control of a wildfire within the individual identified compartments. Fuels at the base of Grasshopper Peak and along secondary roads and trails should be treated. The overall objective in old-growth forests is similar to that in the upper watershed, i.e., reduce fuel continuity and create fuel mosaics. Although the threat of a catastrophic fire isn't as great as in the upper watershed, care must be taken to protect the old-growth forests from possible crown fires.

The last but most important long term priority for the State Park is to use prescribed fire to help regenerate new cohorts of redwood and Douglas-fir. Redwood will not regenerate from seed in its own litter; it needs bare mineral soil or some other kind of organic seed bed. In the absence of fire, windthrow, or human-caused disturbances redwood will not reproduce. They have determined that the easiest way to create appropriate seed beds and to help recycle nutrients is to employ prescribed fire. Douglas-fir, also, reproduces best following disturbance.

BLM LIBRARY
RS 150A BLDG. 50
DENVER FEDERAL CENTER
P.O. BOX 25047
DENVER, CO 80225

BLM LIBRARY
RS 150A BLDG. 50
DENVER FEDERAL CENTER
P.O. BOX 25047
DENVER, CO 80225



GB 992 .C2 S68 1996

South Fork Eel River
Watershed analysis

BLM LIBRARY
RS 150A BLDG. 50
DENVER FEDERAL CENTER
P.O. BOX 25047
DENVER CO 80225